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The Small Computer Magazine

ISSUE #9 September 1977

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SWTPC announces first dual minifloppy kit under $1,000



Now SWTPC offers complete best-buy computer system with $995 dual minifloppy, $500 video terminal/monitor, $395 4K computer.



$995 MF-68 Dual Minifloppy
You need dual drives to get full benefits from a minifloppy. So we waited to offer a floppy until we could give you a dependable dual system at the right price.

The MF-68 is a complete top-quality minifloppy for your SWTPC Computer. The kit has controller, chassis, cover, power supply, cables, assembly instructions, two highly reliable Shugart drives, and a diskette with the Floppy Disk Operating System (FDOS) and disk BASIC. (A floppy is no better than its operating system, and the MF-68 has one of the best available.) An optional $850 MF-6X kit expands the system to four drives.



$500 Terminal/Monitor
The CT-64 terminal kit offers these premium features: 64-character lines, upper/lower case letters, switchable control character printing, word highlighting, full cursor control, 110-1200 Baud serial interface, and many others. Separately the CT-64 is $325, the 12 MHz CT-VM monitor $175.



$395 4K 6800 Computer
The SWTPC 6800 comes complete with 4K memory, serial interface, power supply, chassis, famous Motorola MIKBUG® mini-operating system in read-only memory (ROM), and the most complete documentation with any computer kit. Our growing software library includes 4K and 8K BASIC (cassettes $4.95 and $9.95; paper tape $10.00 and $20.00). Extra memory, $100/4K or $250/8K.

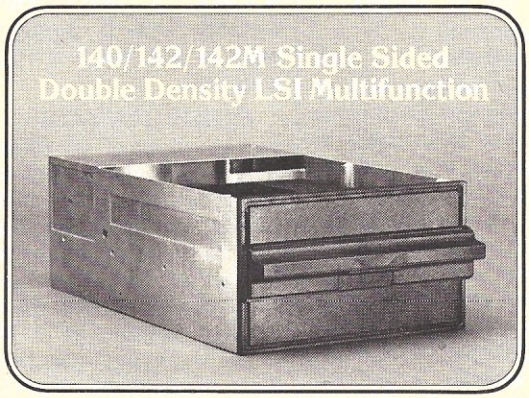
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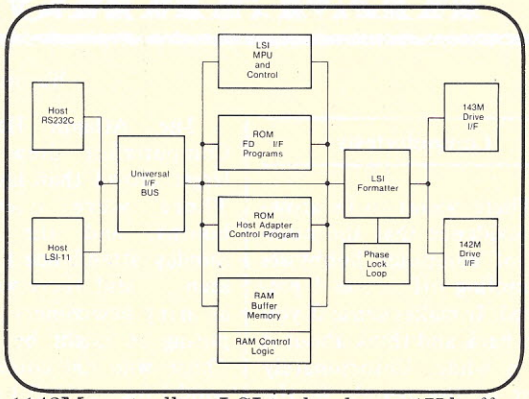
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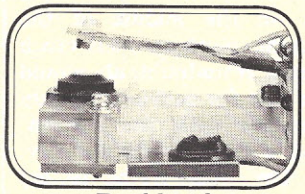
Meet the First Family in floppies.



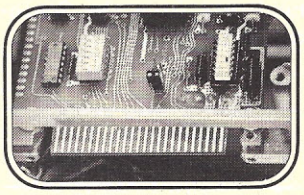
The roots of our floppy family



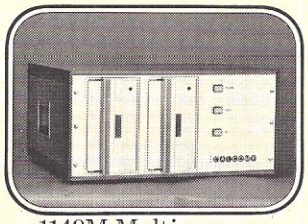
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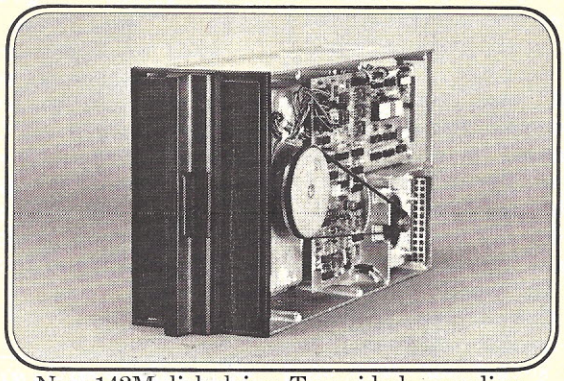
Dual head



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PUBLISHER'S REMARKS

Wayne Green

Computerfests

There seems to be growing evidence that the number of computer hobbyists is leveling off . . . as I predicted. It makes sense if you step back and think about it for a while. Unfortunately most of the people in the industry are wrapped up with their day-to-day problems and haven't given a lot of thought to the long run situation.

The computer hobby is particularly demanding . . . it requires time, money, intelligence, a pioneering spirit, and a willingness to overcome formidable obstacles. Right off the top I think those prerequisites are enough to put a lid on the hobby growth. Just as a measure of comparison, when I look at the ease with which people can get a ham license and then note how few people have the stamina to overcome even that lowly barrier, I am not encouraged to imagine millions enduring the rigors of computer acquaintance on much more than a superficial level . . . perhaps we can agree to call a superficial or diletante approach "personal computing" as opposed to hobby computing.

The Cleveland Computerfest was well organized. There were about fifty exhibits and enough people passing through to keep things humming. It was in no way jammed, and attendance was not substantially improved over last year. *Kilobaud* was there, as was *Interface*. *Byte* was quite noticeably *not* there, leading many people to ask us if they are in trouble or just not further interested in supporting the hobbyists. They didn't bother to support the Atlanta computerfest either!

The Atlanta Hamfest/Computerfest drew a lot larger crowd than last year. There were over 150 booths, and the largest Sunday attendance I've ever seen . . . still, there were not as many newcomers to computing as might be hoped. Those who did come had a good time . . . and I suspect that most of the computer hobbyists from the Southeast did come.

How Can We Get More Hobbyists?

There are a number of people who feel that articles such as are being published in *Personal Computing, ROM,* and even *Creative Computing* will get people interested in hobby computing. I'm not convinced of this, nor have I been able to find any computer store owners who see this working. The reports I'm getting are that interest in these non-specific magazines is not intense and they are cutting back their bulk orders for their stores.

I suspect that if we could provide the simple basic information people need to get started in computing that we would have a lot more enthusiasts. When I look over the articles being submitted to *Kilobaud* for publication I realize how difficult it is for newcomers to even get an inkling of what is going on.

For instance . . . just about all of us have seen or heard about the Cromemco Dazzler, but how many of us understand how it works or just what it can do? A recently submitted article involved a program for plotting on the unit. This was a wonderful opportunity for the author to do a thorough job of covering the Dazzler for us. Instead, I got the feeling when trying to read the article that I had walked in on the middle of the course. Nothing made much sense. It undoubtedly would be fine for someone already familiar with the Dazzler, but it left me high and dry.

I've been trying to get someone to write an article on the Dazzler . . . how it works . . . what it can do . . . when we would use it . . . what programs we need for it and how to write them. I've seen it do Life games and some pretty patterns. Is that *all* it's good for? Apple and ISC also have some color graphics which could stand some revelation too.

The COMPUTERMANIA Concept

In addition to making it easier for people who get interested enough in computers to try and learn via a magazine, we do need to think in terms of attracting a lot more people to computing. This is the basic concept of COMPUTERMANIA. I don't know whether this is going to work or not, but it is worth a big try.

COMPUTERMANIA is an exposition of microcomputers with the advertising and promotion aimed at the general public rather than just the current hobbyists. So far we have seen computerfests promoted almost entirely within the hobby . . . in the hobby magazines. With COMPUTERMANIA, in addition to posters with pre-registration coupons in every computer store in the country and in every ham store in the East, plus in as many colleges and universities in the East as can be managed, there will be ads in *Time, Newsweek, Business Week, Boston, The New Englander,* etc.

The blitz radio and television advertising technique has worked well for movies and is worth a try for an exhibition. Plans are being made for a couple of thousand spot announcements during the week before the show – saturation advertising.

If this all works and we are able to bring people out to see microcomputers in large numbers, the next step is to do our best to communicate with these people . . . not lose them by sticking to computer buzzword put-

Here are some photos of the Atlanta Computerfest taken by Barry Mittan of Objective Design, Inc. With about 7,000 attending and 150 booths of exhibits, it was a crowded show.



Objective Design, Inc.



Atlanta Microcomputerist Hobby Club.



Harry Garland . . . ask to see the insides of the Z-2 at COMPUTERMANIA.

offs.

Hobbyists can help a lot with this project. In addition to getting to see the latest in what's available at the exposition, they can try to act as interpreters between the public and manufacturers who just can't communicate. We just might end up with a lot more hobbyists in the long run . . . and the more of us there are the more equipment and programs we'll all have. We have nothing whatever to gain from keeping computing exclusive.

Cassette Programs

As we move closer to spawning a lot of programs on cassettes to help make our little computers do things, we keep running into problems which call for standardization. It would make our lives a lot simpler if there were one cassette standard . . . one BASIC . . . a standardized system of I/O addresses . . . etc.

The concept, as I explain it to non-computer people, is this: You can compare a computer with a high fidelity system – without program material it doesn't do anything. A hi-fi requires phonograph records with music, speech, sounds, etc., on them before you have any result. The same goes for computers – without programs they do nothing. It is my intention to turn out the programs to enable computers to be usable . . . to have them for sale through computer stores in hundreds and then in thousands.

What kinds of programs will be sold? In addition to such obvious ones as business programs for payroll, inventory, accounts receivable, mailing lists, etc., (and there will be all types of each of these), there will be programs to teach every course which is available in school . . . from simple addition to decyphering hieroglyphics. There'll be programs for handling most math situations, for lawyers, real estate people, dentists, etc. There is virtually no end to the number of programs we can sell.

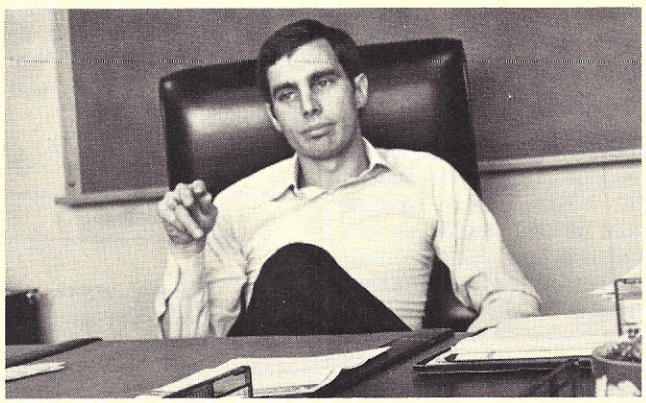
Where will they all come from? With a 20% royalty going back to the programmer who writes the programs being sold, the answer is they will come from anyone interested in making a lot of money. With 50,000 computer stores selling an average of 100 programs a day . . . at an average of $5 each, this means royalty payments on the order of $3.3 million a day. That could be low. A best-selling program, like a best-selling book, could make a programmer independently wealthy. There may be a lot of competition there.

But what about bootlegging? It's possible, to be sure . . . but between setting a relatively low price on each program . . . supplying good documentation with it . . . and copyright, it should not be a serious problem. You've probably noted that even though cassettes and cassette recorders are ubiquitous, record sales have not been seriously hurt. Most

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Almost all of us wish we had a Cromemco Dazzler. But that isn't all Cromemco and its president Harry Garland are up to. You'll be reading more and seeing the Z-2 microcomputer system. Here's Harry showing the super heavy-duty power supply he's building into the Z-2 system. The case is built more like a Mosler safe than a computer, with the intention of keeping the RFI inside the box instead of raising the devil with television and radio reception.

Harry showed how every wire coming out was filtered. Even more impressive was the new Cromemco motherboard used in the Z-2 system . . . it has 50 of the 100 lines on top of the board and the other 50 on the bottom, with wide ground islands between each line of the bus. This helps keep noise down on the system, and reduces the RFI too.



Here's Michael Stone, the director of marketing for Imsai. The newly announced megabyte memory system has shaken up the market . . . and focused more attention on the rapidly dropping prices of massive memories.

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EDITOR'S REMARKS

John Craig

Surplus from the Biggies

Many of those among our ranks are professional computer types as well as hobbyists. Most of you falling into that category work for large (and sometimes not-so-large) computer and peripheral manufacturers. Let's discuss for a moment a shameful situation which exists within most of these companies . . . the wasteful disposal of surplus and obsolete equipment. It's shameful because in most cases this equipment is sold to junk dealers *by the pound!*

There is, of course, a very good reason why companies choose to dispose of equipment in this manner. They want to insure that it doesn't get reconditioned and sold again . . . in competition with their new products. In spite of this reasoning (which is perfectly valid) there must be a way for the hobbyists to take advantage of the situation and get in on some of the good buys. I'm not going to be offering any solutions here because I've never done it. But, I would like very much to hear from those who have checked into the situation to see if there isn't some way for clubs or individuals to purchase some of these goodies.

The goodies I'm talking about range from complete computers down to surplus PC boards. Now, getting hold of PC boards to rob the ICs and discrete components isn't something that appeals to me . . . but robbing them of IC sockets is another thing! I probably have a 5 to 10 year supply of wire-wrap sockets lying around my shop simply because I used to work for a minicomputer manufacturer who threw an enormous quantity (50-gallon drums full) of wire-wrapped boards away at one time . . .and invited the employees to help themselves. As a matter of fact, they *always* had 50-gallon drums filled with surplus PC boards! One time they did a run of wire-wrap prototyping boards which had a slight flaw. There were more of those thrown away than all the interested scavengers could even carry off!

The sockets and the PC boards are just minor examples of the thousands of dollars worth of equipment disposed of monthly by companies all over the country. Why don't you get busy, as a club project (or individual), and approach these companies and see if there is something that can be worked out as far as your getting a chance to bid on this equipment along with those junk dealers? And, like I said before, let us know what kind of obstacles (and success) you encounter.

Advertising?

Carl Warren wrote an article (which appeared in *KB*#6) describing a billing system he developed. Shortly after it was published he received an offer from a company to put him under contract to do similar software development (small business programs). That wasn't his objective in writing the article . . . but it sure starts you to thinking, doesn't it?

NCC

From all the reports I've received the recent National Computer Conference (NCC) in Dallas had a lot of interesting things to see and people to meet. I only wish I could have made it. I want to extend a special thanks to the Personal Computing Committee for inviting me to speak and to the Conference Committee for the invitation to their get-together. I certainly hope the invitations will be renewed next year because I will definitely be in Anaheim. See you there!

Miscellaneous

Red Stolle, and his wife Sue, live on a boat down in the Carribean. During a recent trip around the U.S. they stopped in for a visit which I enjoyed very much. Red hasn't bought his system yet, and the main purpose behind the tour was to check out all the computer stores and manufacturers from here to kingdom come in an attempt to reach a decision. He's got an interesting "problem" because he lives in a 12 V dc environment. He can't just take that computer home and plug it in like most of us can (apparently the marinas down there aren't quite as sophisticated as those in the U.S.). Before going home he decided on, and purchased, a KIM-1 and an Intersil Intercept Jr. (Another one of those lucky retirees who have computers as a hobby!)

THE HEATHKIT FORUM

Charles Floto

Why all the excitement about the Heath Company's computer kits? It's been going on for over two years now. The Micro-8 Computer User Group Newsletter dated August 28, 1975 has a page-two item: "Wouldn't it be neat to know what Heathkit has on the boards. Word around the Bay Area was that Heathkit engineers were making the rounds of the semiconductor manufacturers recently looking at microprocessors."

Part of the answer is suggested by a letter I recently received from New Jersey. Philip J. Bird says: "Having been a Heathkit buff for some 7 or 8 years, I have frequently suggested to them that I was interested in home computer kits."

And from Utah William D. Bradley writes: "I have used Heath gear for many years in hobby, industry and government work areas. It has been considerably improved in capabilities since 1950 when I built my first kits." (Anyone out there been building Heathkits longer than that?)

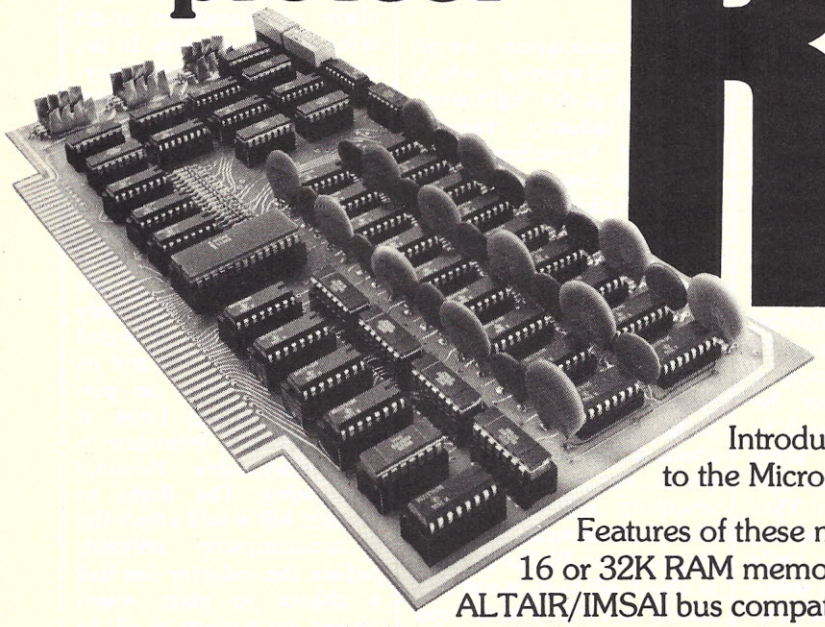
Apparently a lot of hobbyists share the attitude of a professional in electronics and data processing, Florida's Michael A. Francis: "I have held off on any microprocessor development for my personal use until Heath makes the big introduction." He continues: "I have been building, using, fixing and recommending Heath since 1955. And, I will be building one of Heath's first micro kits with its peripherals if my wife authorizes the expenditures . . ."

The long-awaited official

continued on page 19

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LEGAL/BUSINESS FORUM

Ken Widelitz
Attorney at Law

A computer retailers' association you say. Who needs it? What would it do? Why discuss it here? First things first. Who need it most are the over three hundred foresighted persons who have waded, perhaps jumped, into the virtually uncharted waters of owning and operating a computer store.

The phenomenal growth in the number of computer stores has, not surprisingly, paralleled the growth in the microcomputer industry as a whole. Consider that the first computer store opened in July, 1975. The best estimates I've heard (they're not good enough to be called statistics) indicate that as of June 1, 1977, there were three hundred and six computer stores. That means that, on the average, one store has opened every 2.32 days during the past two years.

The proliferation of computer clubs is a testament to the fact that the microcomputer end user has found it necessary to associate with others for guidance, help and, at times, comfort. To make an analogy, the store owners need a national association in the same way that you need a club.

So why do you care about a store owners' association? Unless you own a store yourself, you probably don't. But remember, you can't buy a microcomputer, peripherals, magazines or service from a club. You need a computer store, and you don't want to drive two hundred and fifty miles to find one. Well, if the growth rate continues, you may just have to drive around the block. Of course, a national association of computer store owners in and of itself will not be the most significant factor in realizing the dream of a computer store around the block. However, it can help existing stores stay healthy and give you better service, make it easier for new stores to come into being and help you avoid getting burned by a fly-by-night or otherwise incompetent operation.

Services to Store Owners

Let's examine some of the things a computer retailers' association could do. If you were thinking about opening a computer store, the first thing you should be asking is "How much money can I make from it?" Right now the universal answer is "Who knows?" Oh, sure, if you know a computer store owner, he might tell you how much he made in his first three months or, if he is an old-timer, the first year. That doesn't tell you very much. More important, you can't take that to the bank when you want financing for your store. Even if you've been in operation for a year, loan officers want to know how the industry is doing as a whole. They want to see industry ratios for profitability, sales, margins, inventory turnover, etc. I know from firsthand experience. My XYL (wife in ham lingo) is a loan officer. She is as conservative as any loan officer. She is also the chancellor of the exchequer in our house. Let me tell you, after the hassles I had to go through with her to get funds for my Imsai, I wouldn't want to think about what it would take to get a loan from her.

Anyway, a national association could compile industry ratios. It would be done on a confidential basis so the store down the street wouldn't know exactly how you were doing, but you would know how you stacked up against the industry. That would help you tell if you were spending too much on advertising, or weren't turning your inventory over fast enough, etc.

The association would certainly draft a code of ethics and set standards of competency and service for members. Stores meeting this requirement would be certified and receive a plaque which would be prominently displayed. Potential customers would look for the certificate. Perhaps manufacturers and wholesalers would demand it.

The association would have a newsletter which might act as the "billboard" of the industry, keeping track of hot-selling products. The newsletter might also highlight industry developments, new marketing techniques or expense-saving tips.

It is possible that the national association could provide centralized warehousing for high-priced items. I am not talking about a buying consortium per se, but rather a limited inventory assistance operation. For example, an inventory of three Diablo printers is about all most stores can afford to carry. I have been told the lag time on new orders runs four to six months for such items. What if you, the customer, are fourth in line. You wait or the store owner loses the sale. If you are a business customer, the store owner might lose the sale of the whole system. If the store owner has access to a central warehouse, when he experiences an unusual number of orders in a given week or month, he could draw from the warehouse, save the sale and make delivery in a few days rather than many months. What's the cost? Virtually nothing! The store owner merely has his inventory investment in the warehouse rather than in the stockroom. Warehouse costs, labor and shipping could be met out of savings realized in quantity purchases by the association. In the realm of a pure buying consortium, it might be useful in the capital investment area, i.e., display racks and other store fixtures.

Perhaps you want to finance or lease a computer. Some stores have financing and lease plans available, but you pay a very high interest rate. A national association could possibly negotiate a package with a major financing institution and get more favorable terms because of the volume involved.

One thing a national association could do which no individual store or even a chain of franchises could afford to do is lobby. In the area of legislative advocacy, the interests of store owners are usually going to coincide with the interests of everyone involved in the industry. I'll be getting into the legislative problems facing the industry in a future Forum, but I'm sure many of you are currently familiar with the proposed Right to Privacy bill and its dampening effects on personal computing. Look at the Goldwater interview in the May/June *Personal Computing*. The Right to Privacy bill would affect the microcomputer industry before the industry has had a chance to make much impact on society at all. In the years to come, I'll bet we see legislation proposed which will be directly aimed at controlling personal computers in some way or another.

Computer store owners need liability, casualty, health, life and workman's compensation insurance. An association could make group rates available. It is also possible that an association could make a deal for

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THE BASIC FORUM

John Arnold/Dick Whipple

Several items are before the Forum this month. First we want to thank the readers of *Kilobaud* who have contributed to BASIC Forum in the last few months. We are making every effort to insert your material in our column. Also, a word to those of you who have not written to BASIC Forum. The original purpose of this column was to provide a means for users of BASIC to share ideas – both on an individual-to-individual basis and an individual-to-mass readership through *Kilobaud.*

There are countless books that instruct in the BASIC language. We want BASIC Forum to be more than that. It should provide a mechanism for sharing experiences and problems with BASIC. We do not want to see it serve strictly a one-way tutorial function. In an effort to stimulate some reader participation, we have included this month a problem to solve using BASIC – more about this later.

Tarbell Comments

Two letters arrived recently that we want to consider. The first comes from Don Tarbell of Tarbell Cassette fame. It seems that Don has been on the lookout for some revisions in BASIC. Let's have a look at his comments: "I have been keeping an eye on the BASIC Forum, and have decided it's time to put in my two cents' worth. I've been interested in the problem, because I'd like to program in a higher-level language, and think BASIC is nice, *except:*

1. You can't use alphanumeric labels, making the programs hard to read and debug.

2. Only the first two characters of variable names are usually used by the interpreter or compiler, which also makes it difficult to use meaningful names.

3. Often, there is no good way to save and load alphanumeric data, which is especially useful for business applications.

4. The lack of local and global variable names makes it difficult to use subroutines from a library.

There are other items, but most have already been mentioned in the Forum. It is possible to make an interpreter or compiler that corrects for the above problems, and yet will still run programs written for Mits and other common BASICs.

Enclosed is a request for quotes (RFQ) on an interpreter of this type. I've sent it out to several companies and individuals, with no positive responses.

I would also be interested in an interpreter with the same features, except without the high math of BASIC, such as the trig functions, logs, etc. This would be a good package for very small business systems. I am presently starting to write an interpreter for this language, but don't know if I'll have enough time to complete it, since I'm pretty busy.

I agree that a language is much better if it lends itself to programming in a more structured format, and I think that these additional features will allow that. Actually, the only tricky part of writing an interpreter for this language is retaining good editing features. Note that since the BASIC language is left essentially intact, the "popular momentum" should act in its favor.

Please print the RFQ so that any of your readers who are interested can respond."

Tarbell Electronics
20620 S. Leapwood Ave.
Suite P
Carson CA 90746

Request For Quotes

Gentlemen:

I would like a quote from you, which would state the price and delivery time of an interpreter with the characteristics listed below:

1. The interpreter would run on an 8080 microprocessor-based system.

2. The language recognized by Mits Altair BASIC 8K 4.0 would be a subset of this language, and there would be no conflicts (within reason) with their advanced versions (12K, DISC).

3. All input/output would be performed through a monitor, which could be either separate or a part of the load module.

4. An ASSIGN statement would be added, which would assign I/O functions to I/O devices.

5. Alphanumeric labels would be allowed instead of line numbers, or line numbers could be used, or no labels could be used. This would require a small change in the manner in which the interpreter would recognize immediate execution commands as opposed to program text. I would also require slightly different editing facilities.

6. Variable and array names could be of any length up to 16 characters. Where there were conflicts with imbedded key words, the key word would have precedence. The intent would be to execute the statement so that Altair BASIC statements would be handled properly.

7. Allow the saving onto Tarbell Cassette of the BASIC program or any array (string or numeric), and the loading back in of the program or array.

8. Provide a command to append new program text to the present program text from cassette.

9. Since there might be a label conflict or a variable name conflict after using the facility in #8 above, a BLOCK statement would be required to separate blocks that have independent variable names and labels.

10. So that BLOCKS could be used as subroutines, GOSUBS should be able to have dummy variables as arguments.

11. The interpreter should occupy no more than 16K bytes of memory, and preferably less than 12K bytes."

Our impression is that creation of such a language would be a rather ambitious project. Specifications 5 and 6 above would seem to offer the greatest difficulty. In fact, a BASIC compiler rather than a simple interpreter would probably be required. Although the language enhancements would be welcomed by experienced programmers, we doubt that the average user of BASIC would be much helped. Again we arrive at the problem mentioned by Richard Blumenfeld in the August issue – should BASIC necessarily range too far from its intended purpose as a language for beginning programmers?

Beginner's Hints

Another note comes from George Haller who you remember was the first contributor to BASIC Forum, and who, in fact, had the original idea for the column. George has another suggestion which we like. He wants to see a "Hints or Tips to Beginners" section in the BASIC Forum. He sends along two programming ideas to get things started (see Examples 1 and 2).

The semicolon is the key to the use of a FOR-NEXT loop to print multiple dashes. It suppresses the

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NEW PRODUCTS

Timesharing BASIC Available from Altair

Altair Timesharing BASIC for microcomputers is a unique and dynamic package with powerful capabilities that challenge a field dominated by larger, more costly computers.

Altair Timesharing BASIC and Altair Timesharing Disk BASIC are magnified versions of the powerful and efficient Altair Extended BASIC. Each version includes increased capabilities to accommodate as many as eight different programs running simultaneously and independently within the system.

Input and output are interrupt driven and fully buffered to provide virtually instantaneous keyboard response even when the system supports the maximum number of users. The output buffers empty more quickly than they are filled, thus it will appear the CPU is dedicated to each individual terminal.

Operating within a highly efficient round-robin system, the CPU suspends operation of a job currently being executed, stores the address of the next instruction and moves to the next job. Each job is served a hundred millisecond slice of its program.

Established as a Fixed Partition System, each job is confined to a unique area of memory. Users may then access only their individual jobs, not the system or other jobs. This protects jobs from alteration or destruction.

A variety of input devices can be linked to Altair Timesharing BASIC and Altair Timesharing Disk BASIC. This flexibility permits the use of CRTs for high-speed data manipulations, Teletypes and hard copy terminals when hard copy output is required.

Altair Timesharing Disk BASIC provides rapid loading and program retrieval since all programs reside on a floppy disk. Read and modify passwords may be specified for program fixes to limit access by other users.

Altair Timesharing BASIC can be loaded from paper tape or audio cassette. Programs may be stored for later use on paper tape.

A single Altair 8800b loaded with either version of Timesharing BASIC can be utilized by several students performing independent operations. One student practices program development, another makes use of Timesharing BASIC's extensive diagnostics to debug a program while several other students calculate complicated equations. All program activity occurs simultaneously with no discernable response delay.

Computer-oriented education need not be limited to programming classes. An Altair Timesharing System is a valuable visual tool to assist in the instruction of science, math and engineering classes and as an introduction to the various aspects of computer technology to solve real world problems.

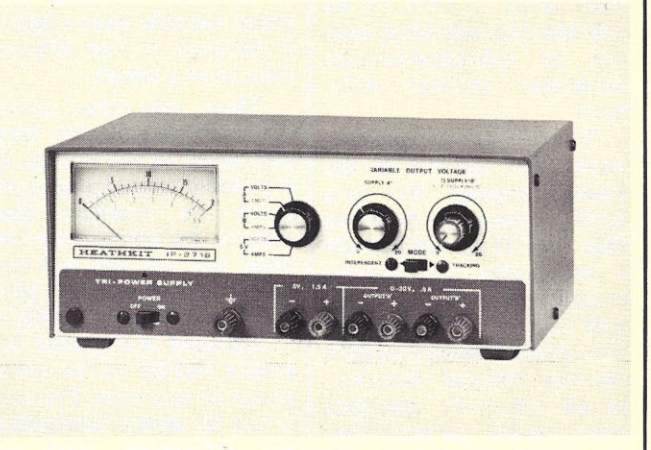
Contact MITS, Inc., 2450 Alamo S.E., Albuquerque NM 87106.

Low Cost X-Y Plotters

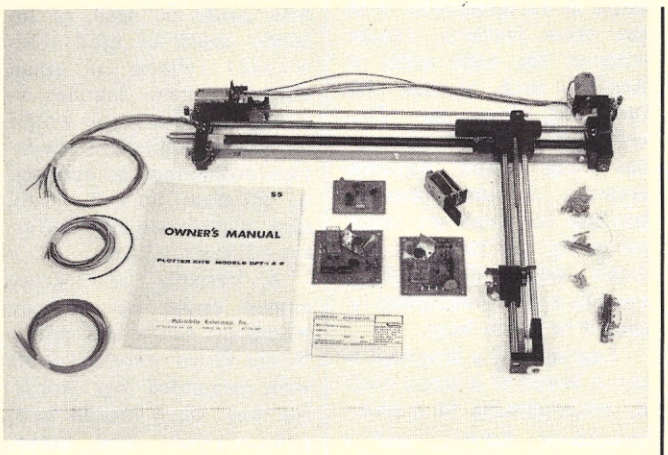
Sylvanhills Lab announces the availability of 8080-based software to control their series of plotters. This enables the microcomputer to act as the controller for the plotter and requires about 2K of memory. The software format is such that it may be used in conjunction with application routines available from Micro-Visions Inc., 4926 Travis, Houston TX 77002.

Plotters are shipped completely assembled and tested, but require the purchaser to mount them on his drawing surface and do the interconnection between the control PC boards and his computer. Requires an 8-bit parallel I/O port and 5 and 24 volt power sources.

Applications include architectural, mechanical, and schematic drawing; PC board artwork; positioning of small objects; computer generated art; games; and many others. Sizes available are 11 x 17 ($750), 17 x 22 ($895) and 22 x 34 ($1200). Sylvanhills Lab, Inc., #1 Sylvanway, Box 239, Strafford MO 65757.



Heathkit Tri-Output Power Supply.



Software Plotter Control.

New Power Supply From Heath

Heath Company has released a new Tri-Output Experimenter's Power Supply. The IP-2718 has three floating outputs that can be connected in any combination for a wide variety of output voltage and current capability. A single, fixed 5 V dc at 1.5 A and two variable 0 to 20 V dc at 0.5 A outputs should prove adequate for most experimental applications.

All outputs are short-circuit proof with current limiting and can be operated independently, in series or in parallel. A switchable front panel meter monitors all outputs.

The IP-2718 is also available in a fully-assembled version, the SP-2718. They are mail-order priced at $79.95 and $140 respectively. Write Heath Company, Dept. 350-24, Benton Harbor MI 49022.

Custom Computer Front Panel

The Computer Mart of New Jersey announced a custom front panel for the SOL and Imsai at the Trenton computer festival.

The user sends in a drawing or an idea (which their artists work on) or simply a name, and they use standard lettering. A photographic negative of the total front panel is then made and inserted into the machine over a light background (white is most effective). The panel cost is $15.

Advertising Department, Computer Mart of New Jersey, 501 Route 27, Iselin NJ 08830.

Computalker Announced

Computalker Consultants announces the Model CT-1 Speech Synthesizer, the first microcomputer plug-in speech synthesizer board capable of truly high quality speech output.

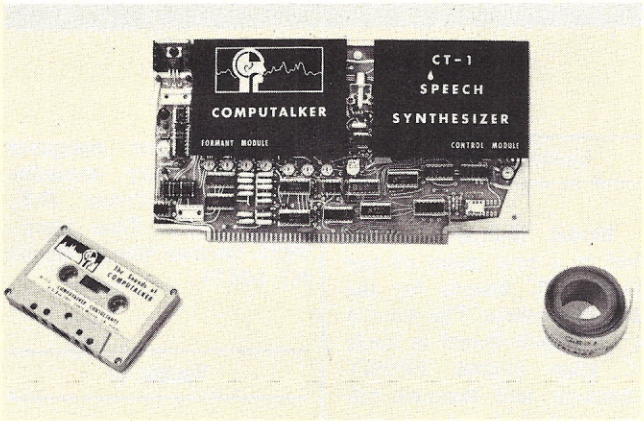
The Model CT-1 optimizes the trade-off between low data rate speech and directly digitized speech. Low data rate speech relies on canned definitions for the sound of each phoeme, which produces mechanical sounding speech. Digitized speech, while remaining faithful to the original sound, requires 10K to 20K bytes per second of storage and is inflexible to phonetic manipulation.

With the Computalker Model CT-1, the sounds are defined in real time under software control. Parameters which represent the phonetic structure of human speech are transmitted to the CT-1 at a rate of 500 to 900 bytes per second, depending on the data compression techniques used. This allows the production of highly intelligible and quite natural sounding speech output. Voice characteristics and language or dialect variations are retained in the output.

The Computalker Model CT-1 can also be operated in a low data rate mode using phoneme definitions contained in the CSR1 Synthesis-by-Rule software package. The Computalker speech synthesis system, used in this way, has the advantage that the software driver can easily be modified to keep the naturalness and intelligibility of the speech output up to date with the constantly evolving state of the art of rule governed speech.

The Model CT-1 is a factory assembled and tested board, 5¼" x 10", which occupies a single slot on the Hobbyist Standard Altair bus. It requires a block of 16 output locations, one byte (8 bits) each, relocatable to any hex boundary via on on-board selector switch. Power requirements are +8 V unreg. (or +5 V reg.) at 170 mA typ., 250 mA max, and ±16 V unreg. (or ±12 V reg) at 85 mA typ.

The CT-1 Speech Synthesizer sells for $395 and the CSR1 Synthesis-by-Rule software package is $35 from Computalker Consultants, P.O. Box 1951, Santa Monica CA 90406.



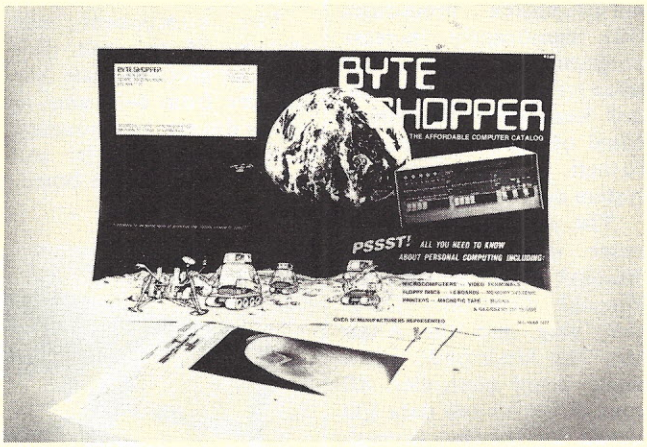
Speech Synthesizer Board.

Byte Shop Mail-Order Catalog

The Byte Shopper is a new catalog designed to present the world of personal computing to the public. The catalog features complete descriptions of microcomputer systems that can meet the needs of the hobbyist or businessman.

It is also an introductory text to personal computing, providing simple explanations of computer buzzwords and graphic visualizations of how microcomputers work and where they can be useful.

The Byte Shopper is informative reading with superb graphics on 11" x 14" pages and a glossary of common terms for easy reference. The guide integrates manufacturer's specs with a down to earth discussion of how to use each product and how it relates to an overall computing system. Several typical systems are pictured and discussed in detail. Over 50 manufacturers are represented with pictures of nearly all products discussed, providing an effective access to the broad range of personal computers, peripherals, accessories and introductory texts. A price sheet is included. From Byte Shops, PO Box 28106, Tempe AZ 85282.



Byte Shopper Catalog.

New Disk Operating System OS-65D

OS-65D is a complete operating system for all disk-based Ohio Scientific computer systems. The OS-65D includes DOS, 8K BASIC, Assembler, Editor, Extended Debugger, and a Disassembler.

By use of overlays, the complete system never occupies more than 12K of memory, yielding high performance on small systems (16 to 20K total memory).

All modules of the system utilize a sophisticated I/O distribution system where any of seven input devices and any combination of eight output devices can be serviced. Standard I/O supported by OS-65D includes a serial port, video display, serial and parallel keyboards, cassette I/O, disk I/O, and a parallel line printer port.

OS-65D has extremely powerful disk file capa-

bilities. The system supports single and dual drives with a variable sector length DOS. OS-65D allows sequential, random access, and indexed sequential disk files in conjunction with BASIC programs as well as program linkage. N number of disk files can be open simultaneously with mixed sector lengths.

OS-65D is now being supplied as standard on all disk-based Ohio Scientific systems and is available to existing owners at modest cost. Ohio Scientific, Hiram OH 44234.

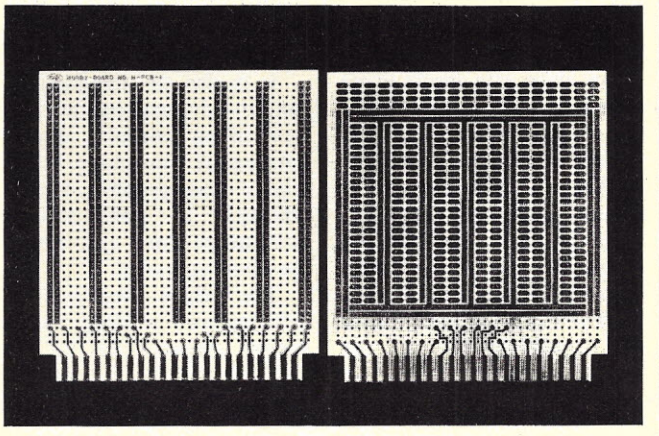
Altair Minidisk from Mits

The miniaturization of mass storage is just one of the exciting features of the new Altair Minidisk System. Designed to work with the Altair microcomputers, the Minidisk has a storage capacity of over 71K bytes per diskette with an access time of less than three seconds.

Altair Minidisk BASIC resides in the lower 20K of Altair 8800b memory (lower 12K in the Altair 680b) and provides the disk utilization routines. Minidisk BASIC includes the standard functions of 8K BASIC plus many extra file maintenance procedures that significantly increase programming power. The software driver for the Minidisk Read/Write functions is based on the hard sectoring format, which simplifies system configuration.

The Altair 8800b computer interacts with the Minidisk Drive through two Minidisk Controller Cards that plug into the Altair bus. The Altair 680b uses a single board controller. All control, status and data I/O signals are handled through I/O ports dedicated to the Minidisk Controller. To insure maximum life of the drive motor, a timer in the Controller turns the system off if the Minidisk is not accessed for five seconds.

The Minidisk Drive Case contains a disk drive, power supply, line buffers and addressing circuitry. The drive address is switch selectable. The selected address is displayed on the front panel for easy identification. Write protect is also a standard feature on the drive. MITS, Inc., 2450 Alamo S.E., Albuquerque NM 87106.



OK's Universal PC Board.

Universal PC Board

Model H-PCB-1 is the first in a new series of top quality PC boards for the serious amateur. The 4 x 4.5 x 1/16 inch board is made of glass coated EPOXY Laminate and features solder coated 1 oz. copper pads. In addition, the board has a 22/22 two-sided edge connector.

The component side contains 76 two-hole pads that can accommodate any DIP size from 6-40 pins, as well as discrete components. Components may be soldered directly to the board, or intermediate sockets may be used for soldering or wire-wrapping.

Two independent bus systems are provided for voltage and ground on both sides of the board. In addition, the component side contains 14 individual buses running the full length of the board for complete wiring flexibility. Available for $4.99 from O.K. Machine and Tool Corp., 3455 Conner Street, Bronx NY 10475.

Vector 1+

The Vector 1+, ideal for business applications, has provisions to incorporate a Shugart mini-floppy or an exact equivalent. Starting at $389 you get an 18-slot, fully shielded motherboard, Altair bus, 6 connectors, a power supply 18 A, 8 V; 2.5A±16V. A whisper fan and a power supply card to modify the Shugart drive are included.

An 8080-based CPU board with 8-level vectored interrupts, a real time clock, and a board with 1K of RAM and room for 2K of PROM designed for an I/O board of your choice is also available.

In addition, the unit requires an I/O board and a terminal or video board, keyboard and a monitor. Vector Graphic Inc., 790 Hampshire Road A-B, Westlake Village CA 91361.



Vector 1+ Accepts Mini-Floppy.

A Computer That Thinks in BASIC

Ohio Scientific's new Model 500 CPU board can be used as a standalone computer or as the CPU in a larger system. The board accepts 8K of ROM, 4K of RAM, 750 bytes of PROM, and ACIA based serial port, a 6502 processor, and full buffering for expansion.

The Model 500 is available completely assembled with 8K BASIC in ROM for $298. By simply adding a terminal and power supply, the user has a complete system which will accept up to 200 lines of BASIC program without expansion.

The Model 500 is software and hardware compatible with Ohio Scientific's 400 kits and Challenger products, thus allowing expansion to a large system.

The board is available enclosed with power supply as the Model 500-1 and is available in an eight slot Challenger case as the Model 500-8. Ohio Scientific, Hiram OH 44234.

Vocal Input to Computer

A new system compatible with all Altair bus computers to provide voice input and control, replacing keyboards in many instances, has been announced by Heuristics, a Los Altos,

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BOOKS

Microprocessor Basics
Edited by Michael S. Elphick
Hayden Book Company
Rochelle Park NJ 07662, $9.95

My first question when I sat down to write this review was whether *Microprocessor Basics* was even aimed at the hobbyist market. The title would seem to imply that it is, but since the book is a collection of reprints from *Electronic Design Magazine* I felt the question deserved close consideration. My conclusion is that the book is not for everyone (but then, what book is?). It should be of great interest to those hobbyists who home brew their systems and those involved in building microprocessor-based controllers. Since the articles are reprints from *Electronic Design* most (if not all) were written for design engineers and, therefore, should be of interest to hobbyist designers.

The book is divided into nine chapters, with six of them devoted to particular microprocessors and design/interface considerations. The 8080 and 6800 are running neck and neck – both have five articles in their respective chapters. The lead article for both chapters is an overview of the 8080 and 6800 written by engineering managers from Intel and Motorola. The 8080 section also contained such articles as "Boosting Bit-Manipulation Capability," "Speeding Microprocessor Responses," "Running Microprocessor Software," and "Designing a Microprocessor Analyzer."

The 6800 chapter contains selections such as "Assembly Language for Microprocessors," "A Universal Test System," "Microprocessor-Based Data Aquisition," and "Controlling Programmable Instruments." From those two lists you can see that substantial portions of the two chapters are devoted to industrial applications.

The first section, entitled "Getting Started with Microprocessors," contains five introductory articles, including "Addressing Modes for Microprocessors" by Dr. Lance Leventhal, who has written several articles for *Kilobaud.* Once again, these articles are directed toward the industrial/commercial design engineer. In a nutshell, the section deals with the hardware and software available to the designer (evaluation kits, development systems, and assemblers).

Other microprocessors covered include the Fairchild F8, the National Semiconductor PACE, and the National Semiconductor IMP-16 chip set. The final chapter is a catch-all entitled "Some Recent Microprocessors," and covers the Signetics 2650, RCA Cosmac 1802, and Intersil 6100 micros.

Surprisingly, nothing was included on the MOS Technology KIM-1 board since it is one of the most popular evaluation/controller boards around (there have been several thousand sold). Another shortcoming is the absence of any articles on the Zilog Z-80.

I think the book will be a worthwhile addition to my library of references. If it had an index, it would be even more valuable; but since most chapters deal with specific microprocessors perhaps that isn't a major point.

Russell Lauffer
Los Angeles CA

SC/MP Microprocessor Applications Handbook
National Semiconductor Corporation
2900 Semiconductor Drive
Santa Clara CA 95051
159 pages,
October 1976

After an introduction and 15-page review of the SC/MP, this handbook describes eight applications in detail – 14 if you include variations. The applications include: electronic combination locks, handling analog-to-digital converters, performing a D/A conversion using the SC/MP and a comparator and an A/D converter, keyboard scanners, a display generator for the Burroughs Self-Scan, a cassette recorder interface to the SC/MP (40 bytes/second), and a Seiko printer interface (handling 13 columns of numerica data and 3 columns of special symbols).

The 14 applications are given in great detail, including the programs.

There are 5 appendices: Clock Considerations for SC/MP, Address Assignments and Decoding Methods, SC/MP Interrupt System, Math Routines, Implementing Program Delays For SC/MP.

The book is well-illustrated (62) with block diagrams, circuit diagrams, flowcharts and six tables.

It is assumed that the reader is familiar with three other publications: 1. The 33-page *User's Manual,* which is very clear, assumes only a basic knowledge of computers and provides one applications example. 2. The 61-page *Technical Description,* the same comments apply. 3. The 103-page *Programming and Assembler Manual,* which is very clear and assumes almost no prior knowledge.

Although this book is not light reading, I heartily recommend it to anyone who has a Scamp. Incidentally, the book is written for the first version of the SC/MP, but would also be useful to someone who has the second version. The first version uses PMOS technology and requires two power supply voltages; the second version is faster, using NMOS technology, and requires only one. The architecture and instruction sets are identical.

Doug Penrod
Santa Barbara CA

Basic BASIC
An Introduction to Computer Programming in BASIC Language
James S. Coan
Hayden Book Co., 1970

This book appears intended for the person who wants to seriously study computer programming in BASIC and at the same time learn some interesting mathematical concepts. It is written in the form of a textbook and could, in fact, be used for that purpose in a computer programming course. Each chapter contains numerous programming examples, a summary, and a set of problems to work out. The problem sets contain both easy and challenging programs with answers to the even-numbered exercises.

Enough BASIC is presented in the first few pages to allow the reader to develop his first program. Of course, access to a computer running BASIC is important. Only in this way will it be possible to test your programs for correctness. Program planning is emphasized with the use of flowcharting. By the end of the second chapter, the reader has been introduced to the PRINT, READ-DATA, LET, REM, and IF statements.

Chapter three introduces the concept of looping and

continued on page 18

LETTERS

Single Voltage A-to-D

I read with interest the article "Only Five Senses" (March '77) by Mark Borgerson. I think his is the least expensive and the most effective analog to digital conversion technique I've ever seen yet. However, I have always been reluctant to use any device that requires a dual-polarity power supply. That was one of the major reasons why I chose the M6800 as my processor.

I don't know much about operational amplifiers but as I see it from the circuit pictured in the article, Mark uses the 741 op amp as an integrator whose output voltage is, as I recall from my school days, always negatively proportional to the integral of the input voltage (or $V_0 = -1/RC \int V_{in}\, dt$). I can see why he uses negative input voltage because a negatively going step at the input from zero to -4.7 volts will produce a positively going ramp from zero to +4.7 volts at the output.

I have a question: Wouldn't it be possible to use one of the newer quad op amp integrated circuits (such as 3900 or 324) which can be operated from a single-polarity power supply, connect the inverting (or minus) input of one of the op amps to +5 V (through R_1 and R_2), and use one of the three remaining op amps as an inverter? And, since most A/D applications require only one voltage channel, what about connecting one more op amp as a comparator? Thus, we would reduce the IC package count to one, dispose of the zener diode, and get by with a single power supply. Any comments?

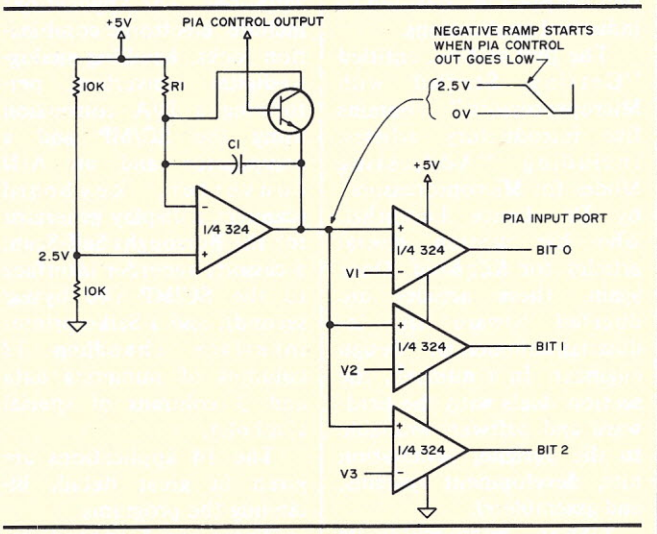
Gustav R. Jindra
San Francisco CA

Reply From Mark Borgerson

Dear John,

I read Gustav's letter with some interest and in the hope that this letter can make your next deadline, I'm sending you a quick (but hopefully reasonable and accurate) response. I won't have the time to try out any of my proposals on the breadboard for several weeks, but I hope one of your other readers will get a chance to try them out.

In answer to Gustav's question about the possibility of using a single power supply and a type 324 op amp all I can say is to try it and see if you can make it work! I've included a tentative design on a separate sheet which should work – or at least come close. Even the professional circuit designers like to prototype a circuit before making any kind of a guarantee. The one major problem I see in using a single-supply op amp with a 5 volt supply is that these amplifiers don't work too well closer than about 1.2 volts below the positive supply. This means that for a 5 volt supply you can only generate a linear ramp up to about 3.8 volts. Limiting the ramp to a 2.5 volt swing should provide a good input range and a nice round number to work with in the computer. The other problem with the single-supply approach is the one Gustav has noted – the ramp will start at a positive value and *decrease* in a linear fashion. This is no problem to the computer – you just monitor the input bits to see when the ramp becomes *less* than the input. The comparator output will change states at this point. The problem you face here is setting the positive voltage level at which the ramp starts. To do this you need two resistors across the 5 volt supply. Thus the voltage at the output of the ramp generator is not only set by the value of the resistor at its current input, but also by the ratio of the two resistors at the non-inverting input. Perhaps this won't even be a problem. If you get a good answer to this question let me know!



By the way, the reason I used a 741 op amp and a bi-polar supply is that both were available . . . and I have used the 741 many times with good results. My computer (as do most systems with 20 mA current loop TTY outputs) already had a ±12 V supply.

Mark J. Borgerson
Corvallis OR

Imsai Controlled Church Service?

Well have we finally reached the ultimate in computerization? It appeared that way with an Imsai 8080 sitting on top of the pulpit near the Altar in front of our church.

A group of us at the church I belong to put on a play the Thursday before Easter. The play was titled "The Verdict" which depicted a modern courtroom trial of Judas. We needed a computer for a prop . . . so why not the company Imsai 8080? I had just completed the "Slow Stepping Debugger" change to the Imsai that appeared in the April issue of *Kilobaud*. It was just the thing I needed to get those impressive slow flashing lights for the "courtroom computer."

After the play I took a picture of the Imsai, but it blurred . . . perhaps there is a power greater than the Imsai 8080.

Bud Cronenberger
Buffalo NY

More Elementary Articles!

Each issue of *Kilobaud* is better than the previous issues – you are setting yourself an impossible task!! Perhaps you have found an application for the Signetics 25120 (9046 x N, RAWOM).

I haven't finished reading issue no. 4 yet but the sorting routines of Andrew J. Rerko are exactly the kind of articles I need! Such routines may be old hat to the experts, but the rest of us still require leading by the hand through the simple routines.

Any chance for one of your authors to write up an appraisal of the HAL MCEM 8080 system?

How about a "Child's Guide" for how to read a waveform diagram? Don Lancaster's articles on clocked logic will probably be of more value to me – when I can read the truth table/decoding states/wave-

continued on page 14

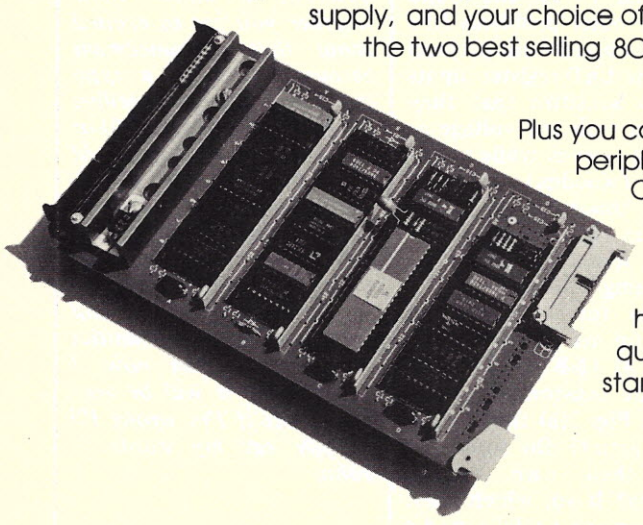
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forms.

Jack Inman's "Number Rounding Program" is more my level.

Would it be convenient for you to put your "Corrections" section on the same page of each issue?? I'd like to turn to that section when I get a new issue, and mark up my previous issues before I get settled down to read the latest issue.

As you may detect, much of the scoop in *Kilobaud* is over my head; but the generous supply of more elementary articles is helping me to learn. As I learn, I can go back and re-read previous issues and understand them the second (or third) time around. Thus, *Kilobaud* back issues serve as an on-going text for me.

Percy Buzza
Nova Scotia

Right on Target

Having already written once to say how much I appreciate your magazine, I will say no more about that except to add that the "Kilobaud Klassroom" is right on target. I plan to start studying just as soon as I can get a Superstrip and some components.

I do have a complaint about the "Features" section in the May issue. The review of EDIT on page 4 refers to a "Table 1"; this table appears on page 5 with a caption that really belongs on page 4 with the Table 1 which is referred to at the end of the Dutronics review, on page 21. Then the BASIC Forum refers on page 17 to two figures that do not appear until page 23. You could at least put page numbers in brackets after the references to these figures so that we can find them without a lot of searching.

Finally, I would like to comment on some of the programs in the May issue. Lee Wilkinson's sales program looks like a good practical application for a small business. His program modification chart is an especially good feature. The program itself could be simplified slightly by replacing lines 50 through 60 with a simple GOSUB; deleting the RETURNs from lines 110 through 160 and adding a single RETURN after line 130. It could also be modified to add up daily or weekly sales figures (see Example 1).

The format of the DATA statements is: TYPE CODE, $ SALES, NO. SALES. A type code of -99 is used to signal the end of this group of data.

David Stanfield's approach to tic-tac-toe has the programmer doing a lot of work that the computer could do. We could number all of the rows, columns, and diagonals and set up two tables: one giving the numbers of the squares on each line and the other telling which lines each square is on. To find a win in one move, we look for a square on a line on which we already hold two squares. To find a win in two moves, we look for a square on a line on which we hold one square and the other square is free. If we can find a square on two such lines, we can set up a fork. We can make the computer's moves unpredictable by shuffling a list of free squares and using this list to determine the sequence in which we evaluate possible moves. This approach has the advantage that it can easily be extended to three-dimensional tic-tac-toe. With some additional programming and a lot of imagination, we could even try a four-dimensional tic-tac-toe.

Randy Foster
Sandusky OH

```
25 FOR I = 1 TO 11: A(I) = 0: B(I) = 0: NEXT I
30 READ I, M, N
35 IF I = -99 THEN GOTO 45
40 A(I) = A(I)+M: B(I) = B(I)+N: GOTO 30
```

Example 1.

KB Klassroom Limiting Resistors

Thanks to George Young for writing what is, to me, the most timely, understandable, and just plain fun series of articles I've encountered so far in *Kilobaud* or any magazine. KB Klassroom is precisely what I need; it is basic, ongoing (for a long time, I hope), and well-written. I especially liked that first project whose main purpose was simply to work. Great for "all-thumbs" like me.

I've been following your articles faithfully every month and always wish they were longer. How about more experiments or schematics to play with?

I've been supplementing KB Klassroom with Don Lancaster's *TTL Cookbook* and with *Bug Book I*. I've built a breadboard console from *Radio Electronics* (Feb-Mar 1975), and found among other problems (it's my first home-built project) that the LED register inputs are so sensitive that they turn on with any voltage or contact – even while sitting in a (wooden) chair, a simple touch of my finger will do it. So now I'm taking it apart and starting over using 7404s.

Now for what all this leads up to. In KB Klassroom #1 (KB #5, p. 121), why are resistors necessary, but in Fig. 7(a) they apparently aren't? Do some ICs have their own current limiting? If so, which ones, and how can I tell? I used a 7404 in the Superstrip and it seemed to work allright – no smoke anyway. Will each 7404 inverter drive one LED (six per package) without resistors? Continuously?

I hope you can help me with this problem. Thank you again for a fine series. Keep it up!

Gordon Furman
Santa Barbara CA 93109

George sometimes forgets to include a current limiting resistor with his LED circuits and I try to catch the omission whenever I can. In an experiment (i.e., short term) it's not too bad to leave it out, but we certainly don't want to build permanent circuits without them. The LED might draw as much as 30 mA without the resistor and as little as 5 mA with it. Needless to say, this means the IC will be working a lot less . . . and live a lot longer. – John.

FORTRAN! FORTRAN!

I cannot believe my eyes that "8080 FORTRAN IV Compiler" by Microsoft didn't even make the index. It got buried in News of the Industry. Really!! If you were around in 1903, would you also have bumped out Wilbur Wright's first flight as so many newspapers did to carry a man bites dog story?

This is the most significant item in this issue.

Lauson F. Pierce
Columbus OH 43219

Lauson, I don't know whether you got so excited about that announcement because we made a typo error and said it was selling for $50 (instead of $500) or because you're an old dyed-in-the-wool FORTRAN man. Either way, it'll be very interesting to see just what impact 8080 FORTRAN has made on the hobbyist, industrial and small business communities three years from now. I don't think it will be very great, but if I'm wrong I'll happily eat my words. – John.

Only One Restored Caruso

Thanks so much for the encouragement on the Digital Audio articles. I've received several interesting letters and comments on the series, and soon I hope I can produce an update installment.

A couple of corrections managed to slip past in the last article (Digital Audio III, the one on signal processing) concerning the work of Dr. Thomas G. Stockham, Jr. R.C.A. has released *one* LP (not "a series of lp's") featuring restorations of recordings of Enrico Caruso by means of digital signal processing. It's called *Caruso, A Legendary Performer* (R.C.A. Red Seal #CRM-1-1749).

I also mentioned that a process had been developed that could remove the *voice* from the orchestral background. This is not exactly so. Dr. Stockham combined his techniques with those of colleague Neil J. Miller to reproduce the voice with the orchestral accompaniment removed. This was accomplished by the use of an Openheim-style, homomorphic vocoder, developed by Miller, which effectively synthesized Caruso's voice based on information processed from the original acoustic recordings. That should excite you computer music buffs: Caruso (and computer) singing again after 60 years!

Tom Scott
Mill Valley CA 94941

TV Mods — Another View

I read Grant Runyan's article "The Great TV to CRT Monitor Conversion" in the July issue, and there are several points I would like to bring to your readers' attention. One is that the 10 pF capacitor across the spark gap SG251 should be rated as capable of withstanding at least 200 volts. Another is that Hitachi has changed the sets so that the more recent ones do not draw current when they are turned off.

Grant is quite correct in saying that the Pickles & Trout kit does not produce materially better results *on his system*. He is using an extensively modified TVT 1 which has 32 character lines and a video signal of 5 volts. The advantage of large bandwidth becomes noticeable with lines of more than 48 characters. Our kit also provides dc restoration, while Grant's circuit does not. The advantage is not noticed until one has a video generator which can do graphics or display either white characters on black background or black on white. In this case the average level of the video signal changes drastically, and without dc restoration the brightness of the display will change and the set may even be incapable of syncing properly.

We have received orders from several people who thought we produced a kit version of Grant's circuit. We do not — the only TV modification kit we produce is the TVM-04, which uses a three-transistor circuit to obtain the performance we consider necessary to satisfy our customers.

Dana Trout
Pickles & Trout
PO Box 2270
Goleta CA 93018

Wrong IC

A bug. Fig. 3 in Michael Smith's "Build Your Own Interface" should be using a 74LS86 Exclusive OR. The board select combination of 74LS08s and a 74LS20 will not work. Trace a signal through. If any switch is closed (to represent a 0, the output of that '08 will be forced low irrespective of the other address input to that '08. That low, in turn, will force the output of the '20 high, and the board will be forced into a nonselected condition. But with an '86 in place of the '08, the circuit will properly compare the high order bits of the address with the switch and give with a boardselect when the address and the switch match.

Or looking at the XOR another way, it can be used as a logic controlled invertor giving a simple switch selected Axx-H or Axx-L for feeding to a '20 for address select.

I have noted that commercial interface boards prevent a board select until certain timing conditions are met from various control lines and then latch the board select in order to hold it until the operation is complete. This may be due to the fact that while addresses are changing a match may be obtained for only a few nanoseconds (maybe tens or hundreds with a MOS CPU) which would cause false board selects and perhaps system bugs when the board responds. My Data General Nova uses all TTL logic in the CPU, but the addresses are not good for about 80 nanoseconds after ADDRESS ENABLE goes true. Gotta make sure the addresses are good before the select compare is performed. Otherwise there is a good chance for initiation of a board action or response on transient garbage. As Mr. Smith says, there are several ways to generate the board select. Fig. 3 will only work for addresses beginning with F_{16} or 17_8.

Dr. Gerald N. Johnson, P.E.
Ames IA

In reply to Dr. Johnson's letter, it is indeed correct that the 74LS08 will not work as shown in Fig. 3. This was a mistake on my part which, unfortunately, was not noticed until the article was already in print. Dr. Johnson is correct in noting that this should have been a 74LS86. Most of my own designs (as well as many commercial designs) use packaged comparators for this function, such as DM8136, etc.

As for the false board selects, there is no problem with Fig. 3 as shown. Keep in mind that the CHIPSEL signals, which are a function of BOARDSEL, are fed only to the chip select pins on the memories. In static memories (such as the 2102 types) this in itself causes no detrimental action. The gating signals (WRITE-L and READ-L) must be active in order to cause memory writing or data bus (DI bus) entry respectively. Note that WRITE-L is gated by MWRT-H from the bus and that READ-L is gated by SMEMR-H AND PDBIN-H from the bus. These gating signals are derived from the 8080A control signals, and by referring to an Intel (or any other manufacturer's) data sheet it will be seen that DBIN and WRT never change when the address lines are unstable. The remaining use of the BOARDSEL-L signal is to enable the changing of the state of the protect flip-flop.

The protect and unprotect functions (from the front panel) are enabled only when the Altair is halted, in which case the address line will be stable (set to the examine address with the CPU "hung-up" in M1 and T2).

A point to keep in mind is that each computer system has bus timing requirements (be it mini, micro, or otherwise) which must be adhered to in order to assure glitch-free operation.

The logic shown in Fig. 3 (with the 74LS08 replaced by a 74LS86) meets all timing requirements for an 8080 being used with static memories, and in fact will work quite well.

Michael L. Smith
St. Louis MO

Robots?

I finally got caught up, just started reading *KB* 6. Concerning Mr. Prudhomme's nice article on the multiplexed scope adapter, shouldn't the designer of the circuit, C. S. Pepper, be given mention for his design (photocopy enclosed)?

Tom Scott's review on "Build your own Robot" was enough to make me order the book. I don't know how many other machine-happy people there are out there, but this book may be just the impetus I need to build something I've been thinking about (and even making mental designs for) for 20 years. As an aside, Tom mentions an article (of which I would appreciate a copy if anyone can accommodate me) by one Robert Rossum. For the non-SciFi people a point

continued on page 20

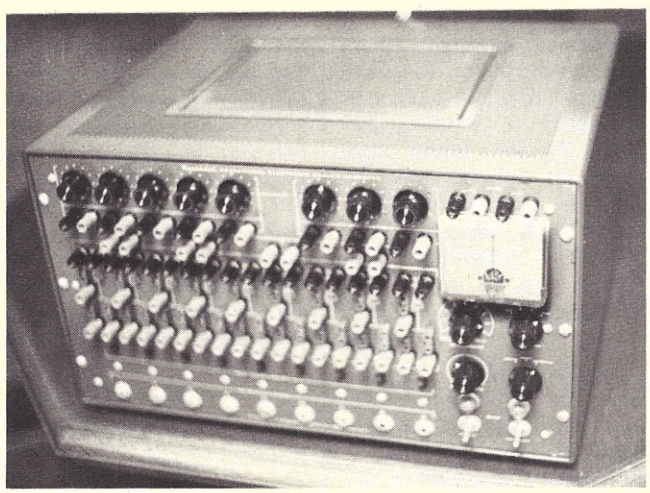
AROUND THE INDUSTRY

John Craig

One Giant Step For Heath

Now we're going to find out just how many of those hobbyists sitting around in a "wait-and-see" mode have been waiting for Heath. How many do you think it will be? You better believe Heath is thinking in large quantities! Lou Frenzel, Director of Computer Products, said that he personally feels the market will grow to over 300,000 in the next few years. After several million PETs, Texas Instruments, and Realistic home computers have been sold, it's quite conceivable that the hobbyist ranks will swell to that number. Needless to say, Heath is planning on getting their share of that chunk ... and with what they have to offer there are plenty of reasons why they should.

The engineering effort which Heath put into the development of their computer systems is the largest the company has ever undertaken for *any product!* Couple that fact with the apparent failure of their simple analog computer in the late '50s, and one can't help but wish them success. After all, if this effort flops, you won't even be able to safely say the word "computer" around Heath for the next hundred years!



Heath's original entry into the field ... their analog computer from the '50s.

Everybody and his brother has been speculating for the last two years as to what processor Heath would wind up using. I, for one, never would have thought they would go with three different chips! It does look like they have all their bases covered though. (Although there is one I'm not too sure about.) The "bottom of the line" is the H-8, an 8080-based machine, which will sell for $375. Their Cadillac is the H-11, which is based around Digital Equipment Corporation's LSI-11. This little powerhouse will be selling for $1295 (gulp!). That's the one I'm not too sure about ... but, we'll see. (By the way, the recommended terminal for the H-11 is the DECwriter II, which sells for around $1900.)



The 8080-based H-8.

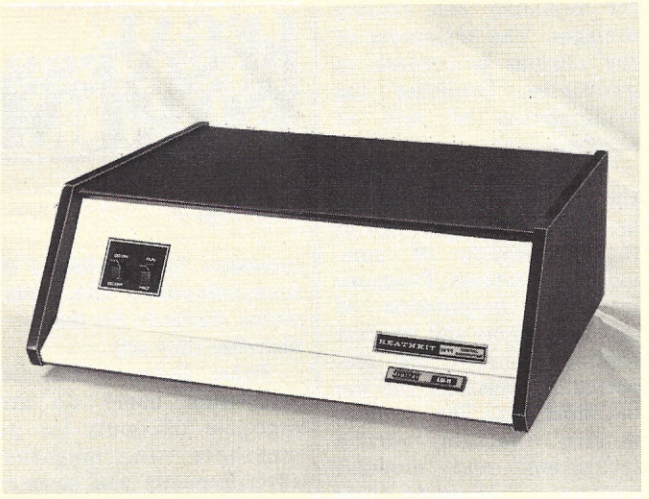


Heath's H-9 Video Terminal.

Some of the peripherals they have available now (others are in the works) include: a video terminal (the H-9) which has an 80 character by 12 line format, optional format selection, cursor control, batch transmit and plot mode. Three interfaces are available: 20 mA current loop, RS-232 and TTL. And ... how about selectable baud rates from 110 to 9600? It will be selling for $530. I loved the smooth feel of the keyboard and everything about the unit except that it doesn't offer lower case characters.

Now for the H-8 ...

It has the feel and look of quality I would expect from Heath. The front panel consists of seven-segment displays for octal readout of data and addresses with an octal keypad used for entering data. The Heath engineers definitely took the right approach by using a keyboard for data entry instead of a row of switches. When you stop and consider the ease of entering data via the former method, compared to the latter, it's really the only one which



The LSI-11 in a new cabinet . . . the H-11.



Finally, an affordable punch . . . with a reader thrown in.

makes sense. Some of the "feel of quality" I experienced was, I'm sure, a result of the audio response provided by the computer's monitor program whenever a key is depressed. The engineers had some rather strong feelings regarding their choice of octal over hexadecimal. They didn't even want to acknowledge the fact there was such a thing as hexadecimal! No big thing, though. The 8080 instruction set lends itself more naturally to octal than to hex anyway. The ideal accessory for an H-8 owner (or any other "octal lover") is the 8080 Octal Code Card from Tychon, Inc., PO Box 242, Blacksburg VA 24060 ($2.95 postpaid). I use the hex version of this handy slide-rule card for my Imsai . . . and wouldn't be without it!

The H-8 doesn't come with any memory for that $375 price tag. Additional 4K increments of static memory (all their expansion memory is static) sells for $140. A serial I/O and cassette interface board sells for $110 and their parallel interface board goes for $150.

Get ready for *Benton Harbor* BASIC! Charles Gilmore, Manager of Design Engineering, pointed out that they had run Tom Rugg's and Phil Feldman's benchmark programs (*Kilobaud*, Issue #6, "BASIC Timing Comparisons") on their BASIC and were quite pleased with the results. I'm hoping we can get those results and include them in an update of the article Tom and Phil are currently putting together. Along with BH BASIC they're also offering an extended version, a text editor, an assembler and a debug program. The only software for which source listings will be provided is PAM-8, the front panel monitor program (which is in PROM).

I honestly don't know where the H-11 (LSI-11) is going to go. DEC certainly hasn't sold very many of them to the hobbyist community . . . but perhaps Heath has a better feel for that end of the market than I do. My biggest problem is that I can't think of that many applications (outside of "larger" small business systems) which would actually dictate the use of an LSI-11 over an 8080-based machine. An interesting "by-product" of the H-11 (since the LSI-11 is somewhat "paper tape oriented") is the first paper tape reader/punch for the hobbyist community. It will be selling for $350.

Heath's third processor is going to be a 6800-based trainer unit (Model ET-3400). They have plans to develop extensive home-study courses around it . . . which is something a lot of people have been looking for. The unit looks like it will be a lot of fun. Word will be forthcoming on availability and what it will cost. (Oops, what's this? I just noticed the keypad on that unit. Looks like someone at Heath believes in hex after all!)

The training program that Heath is putting together for the people in their 47 centers around the country is a tremendous effort and I'm sure they'll find it very helpful if those folks can speak computerese like the rest of us.

As I said in the beginning . . . it's going to be interesting to see just how many people have been waiting for Heath. I'm glad they finally arrived on the scene. ■

THE BASIC FORUM

from page 7

carriage return and line feed that normally accompanies the end of a PRINT statement. Varying results may be obtained using different BASIC interpreters. The semicolon normally produces a single space when separating items in a PRINT list. At the end of a line, the presence or absence of this space depends on the interpreter used. In some cases the dashes will appear with spaces in between. At least one interpreter we know of produces two spaces between dashes. Some interpreters provide a statement to produce multiple character output. These are very convenient when printing headers and doing graphics.

Use of the INT of the LOG of a number will columnize decimal figures without the special formatting features of the PRINT USING statement. A sample program illustrates this procedure (see Example 2).

The key to this trick lies in the use of the base 10 logarithm of the number. For values greater than 1, the whole number part of the base 10 logarithm gives the number of digits to the left of the decimal less one. Thus, in line 40, the number 1.23 produces a full TAB to position 6 [INT

Instead of
PRINT"----------"
to produce a large number of dashes — say 72 — you can use
FOR I=1 to 72:PRINT"-";:NEXT I

Example 1.

```
 5   K1=LOG(10)
10   READ A0
20   IF A0<0 THEN STOP
25   REM LOG(X)BASE 10 = LOG(X)BASE E/LOG(10)BASE E
30   IF LOG(A0)/K1<0 THEN 60
40    PRINT TAB(6-INT(LOG(A0)/K1));A0
50    GOTO 10
60    PRINT TAB(7);A0
70   GOTO 10
80   DATA .01,.12,1.23,12.34,123.45,1234.56
90   DATA -1
```

```
RUN (CR)
    .01
    .12
   1.23
  12.34
 123.45
1234.56
STOP AT 20
```

Example 2.

($\log_{10}(1.23)$) = 0 and 6-0 = 6] while 12.34 TABS only to position 5 [INT($\log_{10}$ (12.34)) = 1 and 6-1 = 5]. In the latter case an extra position is created, causing the decimal points to line up. In line 20, all positive fractions are permitted a full TAB to position 7. A simple PRINT A0 substituted would have produced the following output:

```
.01
.12
1.23
12.34
123.45
1234.56
```

These left justified figures would not be appropriate for columnizing monetary values. The first method is not totally satisfactory for money either. Consider what happens when whole number values are READ and PRINTed:

```
.01
.1
1
10
100
1000
```

What happened to the decimal and zero cents?

Programming Problem

As mentioned at the beginning we have a little programming problem for you to work out. If you are happy with your solution, send it to the BASIC Forum and we will publish the best of those received.

Here is the problem: Write a program that will input a number, say n, then print a list of all prime numbers between 1 and n. A prime number is divisible only by itself and one.

As a benchmark test for your program enter N = 1000 and measure its RUN time. Send us this information and other pertinent details such as which BASIC you are using and the type of output device. We will use the time measurement more to compare your algorithms (solution procedure) than to rate your BASIC interpreter. Write to:

The BASIC Forum
P.O. Box 7082
Tyler TX 75711

NEXT: LOOPING – A case *for* "going around in circles!"

BOOKS

from page 11

one-dimensional arrays. FOR-NEXT statements illustrated with programs for summing and finding averages. The remainder of the chapter is devoted to problems involving the manipulation of lists of numbers.

Chapter four describes the use of functions found in most BASICs as well as the application of user-defined functions. Programs involving computation of prime numbers and greatest common factors are presented to illustrate the use of functions. The random number function, sorting techniques, and modular arithmetic complete this chapter.

Elementary data processing concepts appear in chapter five where the reader is shown how to tabulate results of surveys and questionnaires. The DIMENSION statement and two-dimensional arrays are also introduced.

Data for programs in the first portion of the book are either contained in DATA statements or assignment statements. Chapter six introduces the INPUT statement and data entry directly from the keyboard. At this point, nearly all of the standard BASIC statements have been introduced and the reader should be prepared for the programming techniques covered in the remainder of the book.

Chapters 7 through 13 include applications mostly of a mathematical nature. Among the topics considered are the following: Number Manipulation – Factoring, Solutions of Quadratic Equations, Applications to Trigonometry, Complex Numbers, Zeros of Polynomials, Matrix Manipulation, Probability Applications.

Although the chapters presenting BASIC statements need little mathematical familiarity, the application chapters require some knowledge of high school algebra for full appreciation. Coan's book offers considerable insight into problem solving in BASIC, and would make a fine addition to your personal computing library.

John Arnold
Tyler TX

LEGAL/BUSINESS FORUM

from page 6

insurance for purchasers of microcomputers like some stereo stores do for the merchandise they sell.

Other things a national association could do are negotiate discounts for its members on magazine advertisements and convention booths, provide centralized legal research on issues of importance to the entire industry and even coordinate and sanction conventions and shows.

Perhaps the most important thing a national association could provide is *clout*. For instance, by statute in California, retailers who perform warranty work for manufacturers providing a written warranty are entitled to reimbursement for their time, including a reasonable profit. I have yet to talk to a store owner who has been paid by a manufacturer for providing warranty service. The California statute provides for treble damages, court costs and attorneys fees if a law suit need be brought. No store owner has yet sued a manufacturer because of the fear that if they do the manufacturer will no longer sell to them. However, if the association organizes a class action, the manufacturer can't take punitive action against all stores in California. More on warranty in a later Forum. Clout can also be used against manufacturers who fail to fill orders or who sell a "complete system" without actually having produced one of the components. The implications for the customer are obvious . . . better warranty service, less waiting to receive purchases, no problems with "phantom" products, etc.

The previous discussion only points up some of the potential services which a national association of computer store owners could provide. I'm sure store

owners could think of plenty more. I am also sure some of my suggestions are not viable for one reason or another. So be it. The services to be provided should be dictated by the association members and no one else.

Getting The Ball Rolling

Actually, the ball is already rolling. In conjunction with the National Computer Conference in June, 1977, Portia Isaacson, the Conference Chairperson and a computer store owner, arranged for a meeting of store owners.

At that meeting, chaired by Ray Borrill of the Data Domain, and attended by thirty to forty store owners, I presented a proposal for the formation of a computer retailers' association. My proposal consisted of the purposes and services discussed above along with a proposed budget and by-laws. As I see it, such an organization would be a nonprofit corporation whose officers and directors would be store owners. Its day-to-day activities would be managed by a full or part-time executive director.

The proposal was generally well received. Of course, not everyone there agreed that all the proposed services were desired and others were suggested. But everyone agreed it would be a very good idea to form such an association. As usual with these types of meetings, there was a lot of constructive talk but not much action. The formational stages in the development of national associations can be a vicious circle. It takes people, committees and money to get them going, but most people don't want to commit their time or money until the organization comes into being. For that reason I proposed the following plan of action.

I will establish an interest-bearing Computer Retailers' Association Trust Account. All store owners who are interested in forming a national association should send me a $100 check made out to "Computer Retailers' Association Trust Account." With your check include all of your comments and ideas. If you want to see my proposal and comment on that, please write me for a copy. On November 30, 1977, I will prepare a report for all who have contributed to the Trust Account. If twenty persons respond (it takes twenty members to form a trade association in California) the report will consist of a list of contributors, a set of revised proposed by-laws and a ballot for choosing members of a committee to finalize the articles of incorporation and by-laws. The committee members will probably also serve as the initial board of directors. The Trust Account will be turned over to the committee to get the association formed and underway. If less than twenty persons contribute, the report will so indicate and include a check refunding the $100 plus interest.

So, store owner, you don't stand to lose a cent. Like I said the XYL is the chancellor of the exchequer around here and as a banker, she doesn't miss a trick when it comes to money. It was her suggestion to make the Trust Account an interest bearing account.

Don't miss out on the opportunity to have the association plaque displayed in your store window state "Charter Member."

Microcomputer manufacturers will probably be watching closely. They can have an association too, you know.

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THE HEATHKIT FORUM

from page 4

word came in "The President's Corner" of the Winter 1977 Heathkit catalog: "And what about the most asked question, and that is what are we doing about computer kits? I assure you we are most active, and I have no hesitation to say that you will be greatly pleased with what's coming. An announcement will be made prior to our shipping date, so please be patient with us."

My own reaction was to dash off a letter to Heath Co. president, David W. Nurse: "Your letter in catalog 814 reassures me that we shall soon see the day when any Heathkit using digital circuitry can

easily be linked into a home computer system. This will make possible such applications as computerized weather forecasting using Heathkits to measure time, temperature, and wind speed and direction. We shall also have computers linked together through Heathkit radios and telephone dialers displaying information by direct video input to Heathkit TV."

That's enough of my enthusiasm for now. The family dictionary recognizes "forum" as "a medium of open discussion." Let's hear what you have to say about Heathkit computers. Do you plan to get one? Why or why not? Which Heath system do you prefer and why? What do you like and dislike about Heath's initial entries into the computer kit field? What would you like to see them do in the future? Or maybe there are questions you'd like other reader's help with. In any case, please write to:

The Heathkit Forum
c/o Charles Floto
267 Willow Street
New Haven CT 06511

LETTERS

from page 15

of information: The word robot was introduced by the author Karel Capek in the 20s or 30s in his play "R. U. R." for Rossum's Universal Robots. (Robert Rossum, huh?)

For those who may turn up their noses at robots and mechanical men, let me point out that most societies build their base of power on many kinds (one being slaves, or servants, or machines), and our next big leap may be due to the development of a practical robot. I'd love to see some kind of concentration in *KB* on all those things necessary to robots, i.e., portable micros, electronic to mechanical translation, sensor development, flowcharting for programming and interaction with the outside world.

Finally there is a most important need — good press. Hollywood has created the wrong attitudes for robots, computers and their creators in perhaps 95% of their mention. Non-technical people I have talked to about this make no bones about the fact that they are distrustful and downright frightened of artificial intelligence. Why haven't we seen micros on the popular TV shows, and not as antagonists but as heroes? Science has had a hard time since Hollywood's version of Frankenstein, and now it's Proteus attacking the promise of technology. To those in power, please present a more rational and informative view to the public about these new tools. They may be our salvation.

So much for philosophy and all that, carry on the good work.

Bert Thiel
Frostburg MD 21532

Right. C. S. Pepper's name should have been mentioned in the article's references. (He was not the designer, however. His article dealt with a modification of the circuit.)

With regard to material on robots . . . we haven't been actively looking for it, and it hasn't been coming in by itself either. It does seem to be going to Byte *and*

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Interface Age *(which is okay). If three magazines were concentrating on the subject I think that would be a bit much. – John.*

PUBLISHER'S REMARKS

from page 2

hi-fi addicts do as I do . . . buy the record and make a cassette of it for general use.

The Heath Computers

A lot of us are going to be interested to see what the reaction is to the Heath H11, the 16-bit LSI-11 computer system. I've heard a lot of pros and cons about being a member of Decus. The pro side points out that this enables you to get the huge catalog of programs which are available very inexpensively. The con people say yes, you get the catalog, but when you start looking for practical programs they aren't there. How many people really want a program to calculate the change in weight of the Great Pyramid of Giza when the moon passes overhead? That is an exaggeration, obviously, but I think that all *Kilobaud* readers would like to have some practical advice on the subject . . . what is available from Decus . . . and how much does it cost?

I'm a little perplexed and concerned over the decision by Heath to sell the new system only by direct sale and through their few (about 50) stores. This may in the long run put them at a serious sales disadvantage over firms like Southwest Tech who are selling their kits through computer stores. There is a lot to be said for being able to get help with your system from a nearby store . . . and, as programs become available in large numbers, I think we'll see most computer owners checking in to see what's new in programs for their systems at the local store.

The Heath systems look very attractive . . . and being kits they are ripe for hobbyist action such as a modification to use the Z-80, a 50/100 bus interface so Altair and other S-100 bus boards can be used, etc. The paper tape system has been needed by many hobbyists, and should soon be interfaced with all of the popular systems. We should be running a lot of interesting articles.

Kilobaud Users Groups

If you've worked up any information which you think others using your system might need, why not send it in for inclusion in a Users Group section of the magazine. This will help KIM, SWT, and users of all the other relatively popular microcomputer systems.

Articles Needed

There is so much to write about it is difficult to start with a list. How about an article on starting a computer store? We still need a comparison of the many cassette systems . . . a comparison of the more popular bus structures . . . and the Altair bus could provide a whole series of articles . . . one on the many varieties of standards for the S-100 bus . . . another listing the many memory boards available for the S-100 and the differences between them . . . and how about a list of the boards available for the bus? Has anyone some good ideas on improving the S-100 bus setup?

Future Terminals

Nishi, the editor and publisher of the new Japanese hobby computing magazine, *ASCII*, flew over for the NCC show in Dallas. He brought me the latest in calculators, just released the day before his trip. This was a Sharp EL-8130 Elsi Mate and the surprising thing about it is that it is less than 1/5th inch thick!

The Elsi Mate is 2-5/8" wide by 4-7/8" long and so thin that no one can believe it. This calculator has a touch pad for the numbers which does not move. Every time you press a number there is a little musical tone to let you know you've entered the number. The calculator has a memory function, square root, etc. The readout is liquid crystal and it works like a charm.

It is a lot of fun sporting a fantastic toy like this . . . but even more important to me is what this portends. I can see a terminal built along the same general line with a liquid crystal display instead of a television set or CRT. The keyboard will work just fine for most people for casual computing. Office type computers will want to use the old-fashioned movable keys which are better for trained typists. Remember that less than 1% of the people in the country are trained typists and presumably would easily adapt to non-moving keying-in of data on a computer terminal. That musical tone helps a lot.

Thus we may see a terminal that looks more like a hard cover book. The cover would open up to show the liquid crystal display (LCD), and the display generator chip and a couple of pages of memory would be under the flat keyboard. With batteries it might be only a half inch thick.

Would we connect to the computer by wires, by a UHF radio link, or by a little plug-in glass "wire"?

How much would a terminal like that cost? It could go under $100 . . . maybe under $50. Would you believe $20? Put me down for a dozen.

Flying The Fairchild

Since the game cartridges for the Fairchild Video Entertainment System just houses ROMs, it stands to reason that an enterprising hobbyist should be able to rig up a plug-in unit which will turn the whole thing into a microcomputer. Let's see what you can do with this $170 system.

New England Vacation

Since the chances are good that you'll be coming to Boston for the COMPUTERMANIA exposition, why not take a few more vacation days and see what everyone is making all the fuss about?

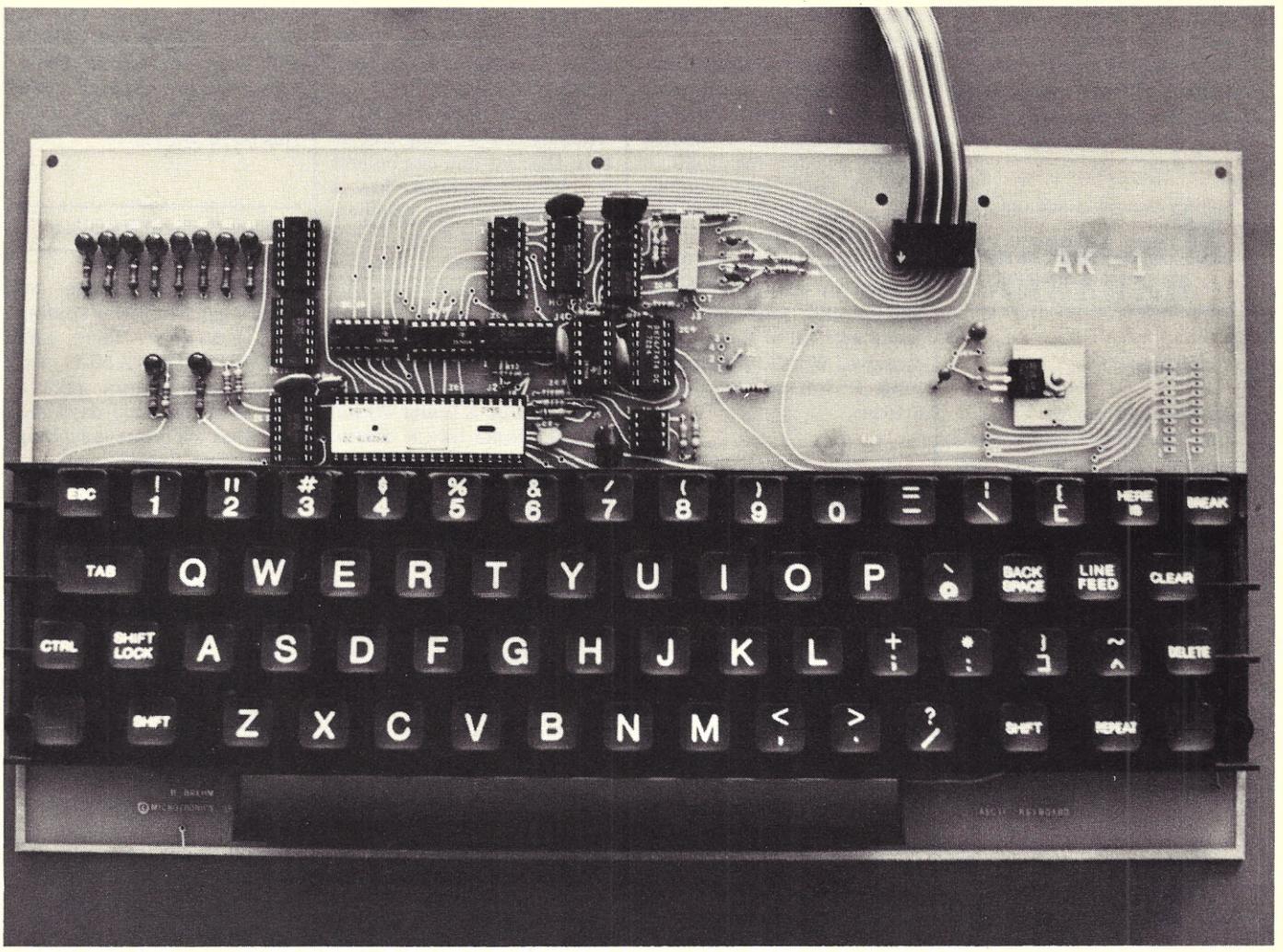
Just about an hour south of Boston is one of the most famous vacation spots in the country: Cape Cod. Here you'll find fantastic seafood, hundreds of motels and some of the best shopping in the country. You might even want to put in some beach time – the Atlantic Ocean is just right at this time of the year.

To the north, also about an hour away, is New Hampshire. It's another hour up to the White Mountains – one of the most beautiful parts of the entire country. You'll want to see The Flume . . . and the Basin. You'll want to take a ride up the first North American aerial tramway on Canon Mountain. The scenery is breathtaking. A little further on you can drive the Toll Road up Mount Washington – a drive you won't forget. That's even more breathtaking.

If you head up Route 95 instead of 93, you'll soon find yourself in Maine. The little coastal villages are wonderful to visit . . . see Kennebunkport. Up further you'll want to stop for dinner at the Red Lion in Bangor and the drive down to Acadia National Park on Mt. Desert Island. For heaven's sake don't miss the afternoon tea in the park . . . fresh hot popovers with jam and homemade ice cream. That's worth the trip.

You'll find the last week of August a great time to vacation . . . it's just before Labor Day weekend when it

continued on page 46



Fully assembled ASCII keyboard.

Robert Brehm
1095 Sherman Ave.
Menlo Park CA 94025

There comes a time in every computer hobbyist's life, after he has put his computer kit together and before he has invented the software program to control the world, when he has to choose an ASCII keyboard to talk with his digital creation. This article is written to help him make this momentous decision by describing an inexpensive, yet versatile, ASCII keyboard kit which features both parallel and serial output in standard TTL and RS232C formats. After reading this article, the computer hobbyist can purchase the kit or apply the ideas to any keyswitch assembly and convert it to an ASCII keyboard for use with his computer.

The keyboard to be described in this article can be put together from readily available parts sold by surplus dealers or it can be purchased as a kit from Microtronics for $89.95 which includes all options and a 45-page technical manual.

The construction technique, theory of operation, computer interfacing and troubleshooting ideas described in the technical manual provide a foundation that the computer hobbyist can use to build a flexible, inexpensive keyboard. This article presents excerpts from the manual in the hope that the information will help the hobbyist increase his technical understanding of keyboards in addition to providing him with practical information for building ASCII keyboards based on ROM encoders.

Keyboard Features

The AK-1 ASCII keyboard from Microtronics utilizes the SMC KR2376-30 ROM which is a MOS 2376 bit read-only memory. This 40-pin chip contains all the logic needed to encode single-pole single-throw switch enclosures into a standard USASCII seven-bit code plus parity. The ROM also features strobe polarity selection, two-key rollover, keyboard debounce and static charge protection of all input and output terminals.

In addition to the ROM, other circuitry incorporated into the keyboard design provides parallel output and simultaneous serial output for driving a cassette recorder or other serial device. Both latched and unlatched strobes are available with either positive-going or negative-going logic which enables the keyboard to be connected to virtually any computer and provide full handshaking capability.

Other standard features of the circuit to be described include the following: electronic shift lock and unlock; odd or even parity selection; uppercase only or upper and lower case operation; two key rollover, N-key lockout; four modes: control, shift, normal, user-defined; repeat circuit that works in any mode; fully buffered outputs for high drive capability and ROM protection; one piece molded plastic keyswitch assembly for keyboard rigidity; premium grade double-sided plated-through PCB; ample power supply bypassing; sockets for all ICs; serial interface (10 cps or 30 cps standard) with TTL output (positive or negative logic), RS232C output, and 12 V

Build Your Own ASCII Keyboard

... with serial and parallel output

regulator circuitry; LED indicators: ASCII code indicators (one per bit to serve as visual key depressed feedback or to check on data code transmitted), shift and control indicators (when shift key or control key is depressed LED is lit); voltage regulators: five volt regulator circuitry, twelve volt regulator circuitry.

Power supply requirements for the AK-1 are +5 V dc, -12 V dc and optionally +12 V dc (only if serial RS232C output needed). These supplies should be well regulated and should be free of transients.

Parts Selection

There are several ways to build a keyboard around the KR2376 encoder chip depending upon where you want to start. If you start from scratch with only the ROM, you have to gather together all the other ICs, the resistors, capacitors, and any other components. More important, you must find a keyboard which has the needed keyswitches. Then, after all the parts are gathered, you have to wire it up and hope that it works. With the information given here, a competent electronics technician can probably accomplish this task without too much trouble. Since the parts used in the design are usually readily available and the keyswitch assembly is sold by many surplus stores, this approach is certainly one to consider if you require a custom keyboard and have the time to gather and assemble the parts.

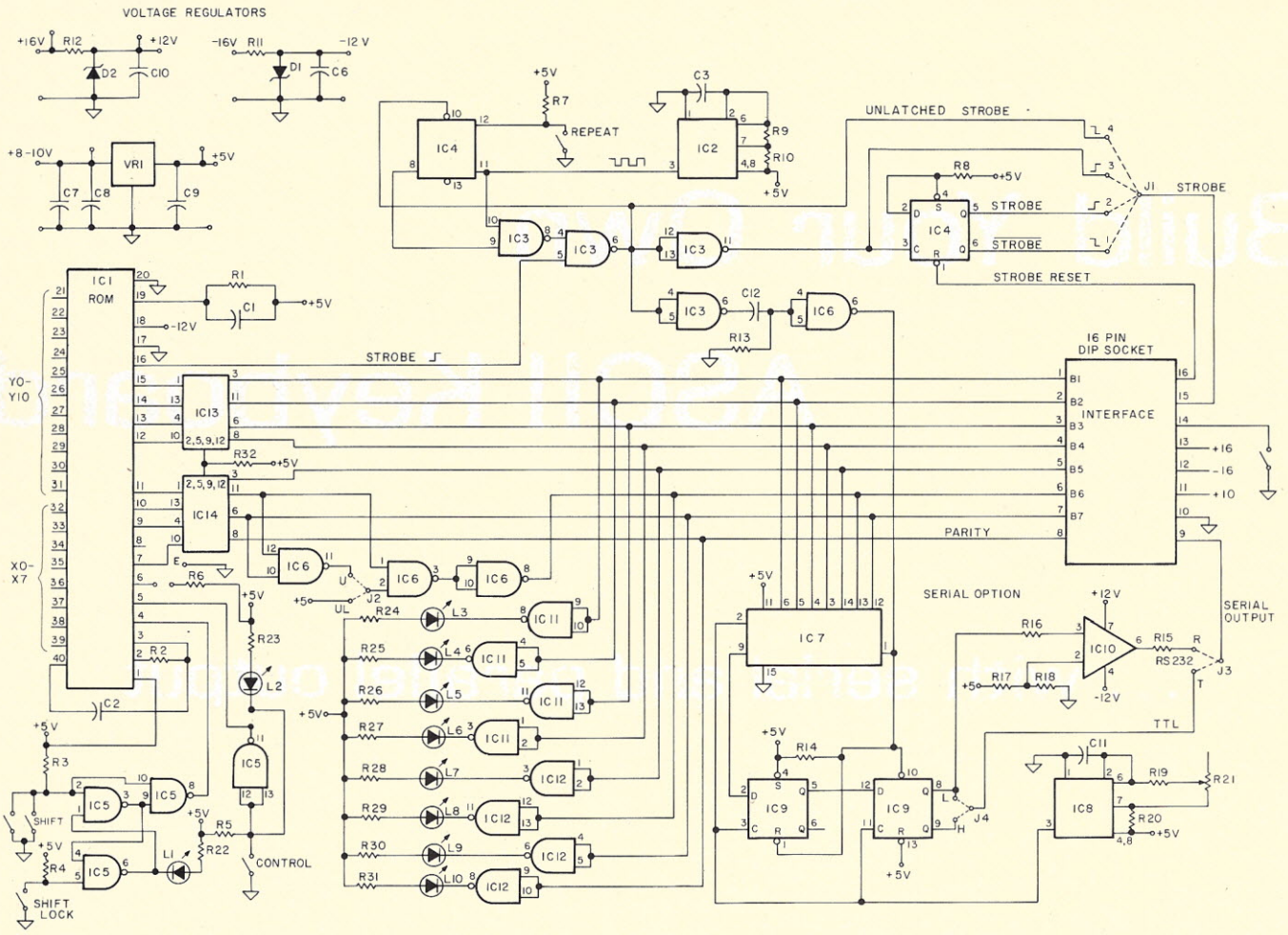
A second, more realistic, approach is to order the AK-1 kit from Microtronics. The advantages are many. First, you only buy the parts needed for your configuration. Second, you get ICs that have been 100% tested prior to shipment. You also get resistors and capacitors that are chosen specifically for the physical and electrical requirements of this circuit layout. In addition, you get a premium double-sided, plated-through printed circuit board which eliminates most of the point-to-point wiring found in many home brew design. Moreover, you deal with only one supplier who specializes in serving the computer hobbyist.

A complete schematic and parts list for the AK-1 is shown in Fig. 1 and Table 1.

Functional Block Diagram and Theory of Operation

The operation of the AK-1 ASCII keyboard can be easily understood by examining the functional areas consisting of the ROM, Shift, Repeat, Strobe, PISO, RS232C, voltage regulators, and LED indicators. A functional block diagram consisting of all of their circuits is shown in Fig. 2. Refer to this diagram and the schematic in Fig. 1 for the following discussion.

ROM circuit: The SMC KR2376-30 ROM is a 40-pin MOS keyboard encoder with all the logic necessary to encode single-pole, single-throw keyboard switches into ASCII code. This IC features TTL/DTL outputs, 2-key rollover, N-Key lockout, self-contained oscillator, a delay network to eliminate the effect of contact bounce, and static charge protection of all input and outputs. In addition, external control is provided for even or odd parity selection. External circuitry has also been added



Capacitor	Value (uF)	Type
C1	.001	disc
C2	47 pF	disc
C3	.1	mylar
C4-C5	.1	disc
C6	1.0	tantalum
C7, C9	.1	tantalum
C8	15	tantalum
C10	1.0	tantalum
C11	.1	mylar
C12-C14	.1	disc

Resistor	Value (Ohms)
R1	680k
R2	100k
R3-R8	2.2k
R9-R10	470k
R11-R13	510
R14-R15	2.2k
R16	47k
R17	4.7k
R18	3.9k
R19	2.2k
R20	47k
R21	10k
R22-R31	330
R32	2.2k

IC No.	Type
IC 1	KR2376-30
IC 2	555
IC 3	7400
IC 4	7474
IC 5, 6	7400
IC 7	74165
IC 8	555
IC 9	7474
IC 10	741
IC 11, 12	7400
IC 13, 14	7408

Diode	Type
D1	IN5242 zener
D2	IN5242 zener

VR1 is a 5V regulator

Fig. 1. ASCII keyboard schematic diagram.

to allow upper case only or upper and lower case only selection.

The X-Y matrix wiring chart for the full ASCII character set is shown in Fig. 7. Each X_i, Y_j switch can generate three different codes depending upon the voltages present on the shift (S) and control (C) inputs. Mode selection logic is shown in Fig. 3.

The control function is enabled by grounding a 7400 NAND gate which also causes the control LED to light. Unlike the shift circuit, the control mode requires the continuous depression of the control key.

The RC (R1 C1) circuit on pin 19 of the ROM provides a strobe delay of 1.5 ms after the data on the output has become valid. The RC (R2 C2) circuit on pin 2 of the ROM sets the debounce oscillator frequency to 50 kHz.

Shift circuit: The AK-1 features an electronic shift lock circuit. It is not necessary to hold down the shift key to obtain upper case operation. All you have to do is tap the shift lock key. To revert to lower case operation just tap the shift key. If you want to shift for only one character, just hold the shift key down for that character. The circuitry is a set/reset flip-flop made with two sections of a 7400 NAND

Standard Parts Kit
Integrated Circuits
1 – KR2376-30 ROM (IC 1)
1 – 555 (IC 2)
3 – 7400 (IC 3, 5, 6)
1 – 7474 (IC 4)
2 – 7408 IIC 13, 14)

Resistors
7 – 2.2k Ohm, ¼ Watt, 5%
1 – 680k Ohm, ¼ Watt, 5%
1 – 100k Ohm, ¼ Watt, 5%
2 – 470k Ohm, ¼ Watt, 5%

Capacitors
1 – .1 uF mylar
1 – 47 pF disk
1 – .001 uF disk
4 – .1 uF disk
1 – 1 uF tantalum

Miscellaneous
1 – Keyswitch assembly
1 – AK-1 PC board
1 – 16 pin DIP socket
1 – 40 pin DIP socket
1 – Hardware package

Optional Parts List
LED Indicator Kit
2 – 7400 ICs
10 – 330 Ohm, ¼ Watt, 5%
10 – Light Emitting Diodes
1 – .1 uF disk

Voltage Regulator Kit
1 – 12 V dc, ½ Watt zener diode
1 – 510 Ohm, ¼ Watt, 5%
1 – .1 uF disk
1 – 15 uF tantalum
1 – 340T-5.ov or 7805 UC

Serial Interface Kit
ICs
1 – 74165 (IC 7)
1 – 555 (IC 8)
1 – 7474 IC9)
1 – 741 (IC 10)

Rs
2 – 510 Ohm, ¼ Watt, 5%
2 – 2.2k Ohm, ¼ Watt, 5%
1 – 47k Ohm, ¼ Watt, 5%
1 – 4.7k Ohm, ¼ Watt, 5%
1 – 3.9k Ohm, ¼ Watt, 5%
1 – 30k Ohm, ¼ Watt, 5%
1 – Timer Potentiometer*
1 – Timing Resistor**

Cs
3 – .1 uF disk
1 – .1 uF mylar
1 – 1.0 uF tantalum

Regulators
1 – 1N5242 12 V, ½ Watt

Speed	*	**
10 cps	50k	33k
30 cps	20k	2.2k

Table 1. AK-1 ASCII keyboard parts list.

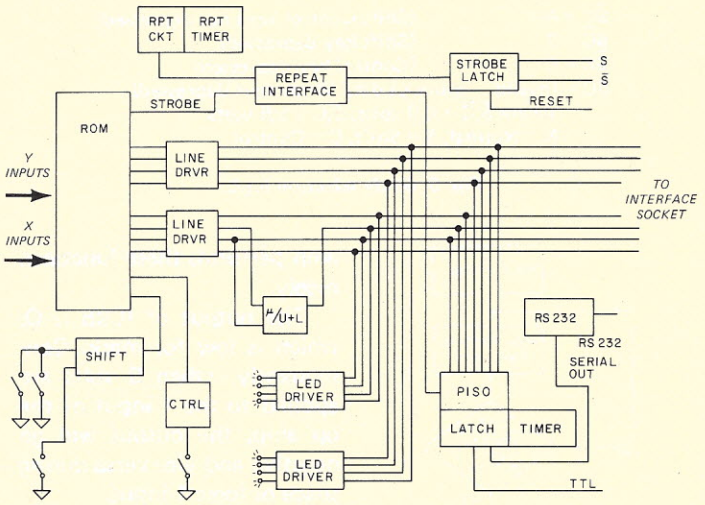


Fig. 2. AK-1 functional block diagram.

gate with some additional gating to reset the flip-flop when the shift key is touched. When the shift lock is hit, IC5B output goes low and causes the LED to light. At the same time, IC5C goes high enabling the shift function in the ROM.

Strobe circuit: The strobe circuitry used in the AK-1 allows maximum flexibility in choosing a strobe pulse that is compatible with your microcomputer. Both unlatched and latched strobes are provided which may have either positive-going or negative-going logic. The unlatched strobe is present as long as the key is depressed; the latched strobe is present after the key is depressed until it is reset by the computer. Each new strobe pulse will set the latch after it has been reset. After each character is read by the computer, it should reset the latch in order to recognize the next strobe from the next character.

The latch used in this circuit is a 7474 edge-triggered flip-flop which is hardwired to provide +5 V on pin 5 whenever a strobe is present (called a positive-going strobe, ⌐‾), otherwise it will be zero when reset by the computer. Pin 6 of IC4 provides the opposite type of latched strobe; one going from 5 volts to zero volts (called a negative-going strobe, ‾⌐).

Depending upon your computer input requirements, you may select the latched or unlatched strobe by placing jumper J1 to the appropriate strobe.

Repeat Circuit: The repeat circuit consists of two functions, the timing and the clocked repeat section. The timer is a 555 wired for a stable operation at approximately five characters per second. Higher or lower speeds may be obtained by changing resistors R9 and R10. However, the repeat clock speed must be less than or equal to the serial output clock speed, if it is used, in order to prevent data overrun. Clock pulses are fed into pin 11 of IC4 which is hardwired to provide a logic 0 (low) $\overline{Q}$ output when the repeat key is not depressed. This is fed to IC3A and has no effect on the strobe going into IC3B since IC3A output is high. When the repeat key is depressed, $\overline{Q}$ goes high and the clock pulses are routed through IC3A to IC3B. When the strobe is high into IC3B, the clock pulses are fed to IC3C, inverted and used to clock latch IC4B. When the repeat key is depressed or released, the D flip-flop ensures that the repeat clock pulses always end on a level transition rather than during the pulse, thus providing timing independence of the repeat key and a predictable number of repeated characters.

PISO circuitry: The Parallel-In-Serial-Out (PISO) circuit is probably the most complex of the functions besides the ROM itself. It provides keyboard users the option of using serial interface through two wires (signal, ground) rather than nine wires (eight parallel output, ground) to their computer. It also gives the capability of simultaneous parallel and serial output which allows one keyboard to input data to the computer and simultaneously input data to a cassette via a cassette interface.

The PISO function consists of a timer and a 10-bit shift register made up of an 8-bit shift register (IC7) and two-bit flip-flops (IC9). The timer is set to 110 Hz for 10 cps or 300 Hz for 30 cps. A ten-turn potentiometer is provided to adjust the frequency to that used by your serial interface.

The PISO is driven by the strobe circuit through IC3D and IC6A which serve to convert the strobe level change to a narrow .5 ms negative-going (⌐‾⌐) pulse, Under steady state conditions, when no character is being sent, pin 9 of IC9 is high (+5 V) which represents a mark. When a key is depressed, the strobe pulse sets IC9B, thus forcing Q, or pin 9 of IC9B to remain high for the start of the serial bit stream. This 1 can be any width, from nothing to slightly less than one clock

$\overline{S}\overline{C}$ = N (Shift Control keys not depressed)
$S\overline{C}$ = S (Shift key depressed)
$\overline{S}C$ = C (Control key depressed)
SC = Invalid — spurious data (Both keys depressed)
where $\overline{S},\overline{C}$ = 0,0 volts, S,C = 5,5 volts
N = Normal, S = Shift, C = Control

Fig. 3. Mode selection logic.

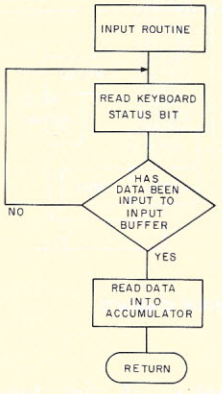


Fig. 4. Keyboard input subroutine.

cycle width, since the strobe pulse can arrive at any time with respect to the beginning of the clock cycle. Consequently this output 1 is probably a short bit and is used to absorb the difference between clock timing and the instant the strobe is detected.

At the same time the strobe set IC9B, it reset IC9A, Q, to low. Therefore, during the next clock pulse a space or logic 0 is transmitted signifying the start of the serial character.

The rest of the code, loaded into IC7 during the strobe, will follow in sequential order. The parity bit is hardwired to be high at all times. After these 8 bits, 2 logic 1s are transmitted signifying the end of the character. Until the next strobe pulse, the output is held in the mark position (logic 1).

RS232C interface: The RS232C interface requires -12 V for a mark and +12 V for a space with the same 11-bit character stream as provided in the serial TTL output previously discussed. Consequently all we have to do is provide a logic level shifter to do the voltage changes. The versatile 741 op amp performs these functions nicely.

The output of IC9B is Q, which is low for mark. Consequently, when 0 volts are applied to the + input of the op amp, the output will go negative and vice versa during space or logic 1 input.

Either serial output may be selected via jumper J3. In fact, both serial outputs may be used simultaneously if you have the capabilities to utilize them. (Thus providing three simultaneous outputs from the keyboard!)

Jumper J4 selects positive or negative logic for the serial TTL output.

Voltage regulator circuits: Both the ±12 volts regulator circuits utilize zener diode regulators since the current drawn by the keyboard circuit is very small. A 1 uF capacitor is provided on the output for transient suppression and high frequency smoothing.

The five volt regulator utilizes a 7805 or 340T-5 voltage regulator rated at 1 Amp. Since the fully loaded keyboard draws only 350 mA at 5 volts, this regulator is well within its ratings. Two input capacitors are included on the input for regulator stability and decoupling. The output capacitor helps transient response.

LED indicator circuit: The 8-bit parallel output line is coupled to the LED ASCII code indicator via 7400 NAND gates configured as invertors and acting as LED drivers. When an ASCII bit is high (+5 volts) the output of the LED drivers will be low, causing the LED to draw current.

During standby, all inputs will be high and consequently all LEDs will be lit. The LEDs are arranged on the keyboard such that the rightmost LED represents the least significant bit (B1) and the leftmost LED represents the parity bit (B8). The ASCII code for any depressed key will be shown on the LEDs as a lit LED for 1 and a dark LED for 0. It is very interesting to watch the parity bit change as the code changes. With even parity, you should always have an even number of LEDs lit and with odd parity an odd number should be lit in the upper and lower case mode.

Computer Interfacing

Interfacing the AK-1 to your microcomputer should be very easy due to the flexibility of the interface circuitry. The hardware and software ideas presented here should enable you to successfully interface your keyboard to most, if not all, I/O interface boards on the market today.

Parallel interface: The polarity of the parallel data output is hardwired for positive logic with +5 V = "1", or 0 V = "0" since this type of logic is the most commonly used for hobbyist applications. If your computer programs require negative logic, it is an easy matter to complement the ASCII character via software to obtain this result.

The ASCII output of the AK-1 keyboard is not latched as most interface boards have on board 8-bit parallel latches. This means that the data is valid on the output lines only as long as the strobe or data available signal is valid. As a result, your software computer program must have some way to recognize when to read the ASCII character on the data lines or in the I/O board latch. This is typically done with a status bit in a status word or 8-bit channel (as used on the 3P+S) or a status bit on a flip-flop. In either case, the status bit is set by the strobe from the keyboard. With the AK-1 you have a choice of a latched or unlatched strobe with either positive-going (0 V to +5 V) or negative-going (+5 V to 0 V) logic. In general, if your I/O interface board *does not* have a status bit latch circuit, then you should use the latched strobe available from the keyboard. If you do have an on board latch (or flip-flop), then you can use the unlatched strobe from the keyboard. Your I/O interface board manual will tell you whether you need a negative-going ($\overline{\text{STROBE}}$) or positive-going (STROBE) strobe. Choose the appropriate strobe by placing jumper J1 to the appropriate hole.

```
READ    IN      STATUS      READ STATUS BIT
        ANI     40H         LOGICAL "AND" WITH (01000000B)
        JZ      READ        NOT READ, TRY AGAIN
        IN      DATA        READ DATA INTO ACCUMULATOR A
        RET                 RETURN TO MAIN PGM
STATUS  EQU     02H         (STATUS PORT)
DATA    EQU     03H         (DATA PORT)
```

Fig. 5. 8080 machine language program to read keyboard data. Program first checks keyboard status bit for a 1 value, then reads value into Register A.

```
LOOP    CALL    READ        (PREVIOUS SUBROUTINE)
        CMA                 COMPLIMENT DATA FOR LEDS
        OUT     0FFH        FF IS FRONT PANEL OUTPUT PORT
        JMP     LOOP        JUMP TO NEXT CHARACTER
```

Fig. 6. 8080 program to display keyboard data on front panel lights of Imsai 8080 requiring complement logic.

If you use the latched strobe, you have to provide a negative going(⎍⎍ $^{+5\ V}_{0\ V}$)reset pulse to the reset terminal of the strobe latch. Many I/O boards generate this pulse automatically when a read command is executed by the software program. If your I/O board has an on board latch, the signal is probably generated on board to reset the latch so you don't have to do anything.

Serial Interface: If the optional serial interface kit is purchased for the AK-1, you can use a serial port on your I/O board for the keyboard interface. If, on the other hand, you use a parallel interface to your microcomputer, you can use the serial interface to drive any of the popular cassette interface boards on the market today. In either case, you have to properly set the timing of the serial bit stream.

Interfacing serial data to your computer requires several steps. First, you must determine what voltage levels your serial port requires. The AK-1 can supply TTL levels with mark = +5 V and space = 0 V or standard RS232C levels with mark (logic 1) = -12 V and space (logic 0) = +12 V. For either voltage level, no strobe is needed since it is part of the serial data stream. After the voltage level requirements have been determined, the speed must be chosen. The AK-1 can be wired for either ten characters per second (teletypewriter speed) or for 30 cps. Since most people can't type 10 cps, either speed is quite satisfactory and the choice depends on the speed capability of your I/O interface board. Once you have chosen the speed and set the speed on your I/O board, you have to adjust the timing potentiometer on your keyboard. Before you do this, check that you have the proper timing resistor for the speed you have chosen. For 30 cps R19 = 2.2k, and R20 = 47k; for 10 cps R19 = 33k, R20 = 30k.

The correct method to adjust the frequency utilizes a frequency counter or triggered oscilloscope. If you have a frequency counter, adjust the 555 timer output (pin 3) for 110 Hz for 10 cps or 300 Hz for 30 cps. If you have a triggered scope, press any key, measure the serial output and adjust one ASCII bit for 9.0 ms for 10 cps or 3.3 ms for 30 cps.

Software Considerations

Now that you have the hardware interfaced correctly to your I/O board, it is time to try it out by writing a keyboard input program into your computer's memory. The software given in Fig. 5 is for the popular 8080 chip used by the majority of hobbyists.

In order to familiarize yourself with the required steps in the program, a program flowchart is shown in Fig. 4. Note that the sample program to be illustrated doesn't use hardwired interrupts but incorporates software interrupts as do the majority of computer hobbyist installations.

The code for either serial or parallel interface is the same as shown in Fig. 5.

In the main program, the input routine would be used by initiating a CALL READ statement after which the input data would be present in Accumulator A.

The program in Fig. 5 assumes that the I/O board strobe latch or the strobe latch on the keyboard is reset automatically via the hardware. For serial data, the strobe on the UART (RDA) is normally reset by hardware. It has also assumed that the data port address was Ø3 and the status port address was Ø2 with the strobe or data available bit being B7. You may of course change port addresses and strobe bit position to suit your I/O board requirements.

If you want to check the code generated by the keyboard, and you have front panel indicator LEDs as does the Imsai 8080, you can run the program illustrated in Fig. 6 which puts the data on the LEDs.

The CMA, or complement accumulator, is required because the Imsai LEDs work on negative or complement logic with respect to the ASCII keyboard input.

Upper Case Only Section

Many AK-1 users will undoubtedly want to use the upper case only option which is jumper selectable on all standard keyboards.

By selecting upper and lower (jumper J2 to U+L) all upper case (shift), lower case (normal) and control character represented by the keyswitches are capable of being generated by the AK-1. If you desire switch selectable U+L or U only alphanumeric generation, a single-pole, double-throw (SPDT) switch can be installed on your keyboard case with the center pole going to hole J2 and the outside poles going to the U and U+L holes.

There you have it. A complete description of a keyboard with many options that should provide a versatile and flexible keyboard for hobbyist applications. You can now make the momentous keyboard decision and start to enjoy your electronic creation. Happy computing!

If you decide to order a keyboard from Microtronics, please include $3 for shipping and handling and 6% tax (CA residents only) to: PO Box 7454, Menlo Park CA 94025 ■



Fig. 7. Key switches hooked up to the AK-1 keyboard. Chart shows the ASCII codes available in the KR2376-30.

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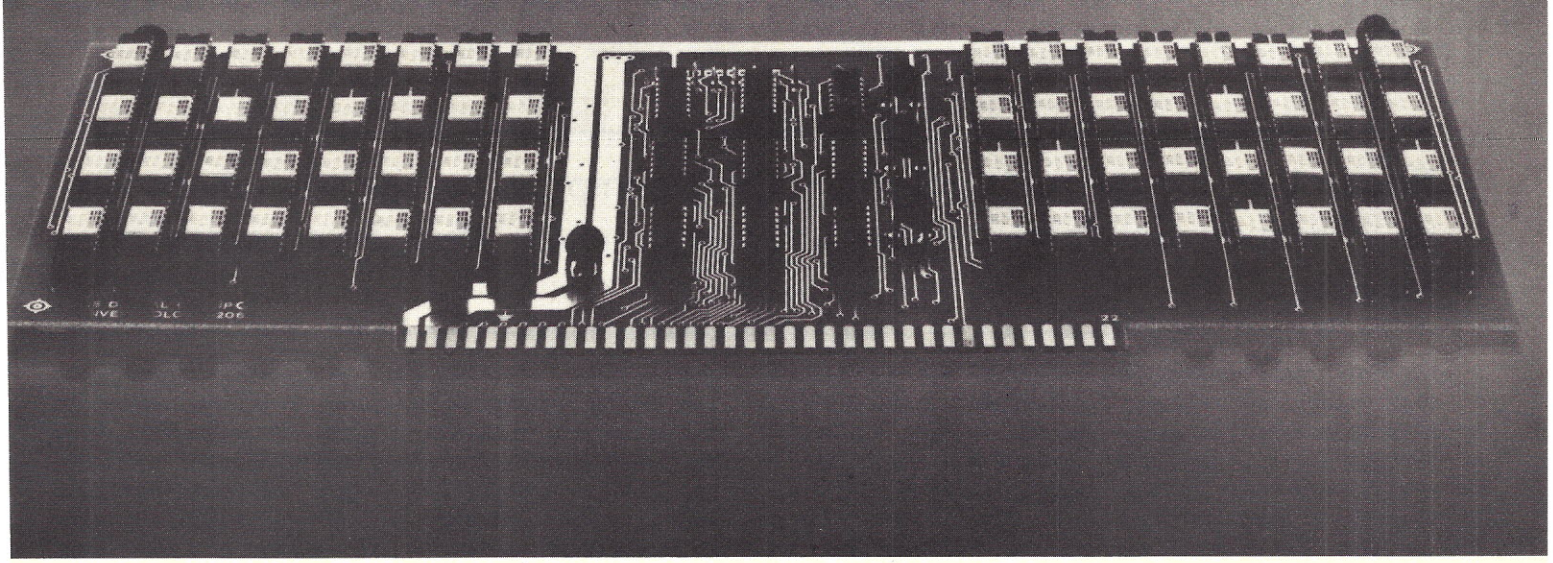
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Lawrence R. Zeitlin

The Ultimate Personal Computer

Forget learning the multiplication tables, compress college attendance into an afternoon, and master a new language in hours. Dick Tracy would have loved it.

Dr. Zeitlin has been involved with computing machinery since he was awed and partly deafened by the Aiken Mark II at Harvard in the late '40s. Subsequent exposures were to the pin-programmed Burroughs 101, the Bendix G15, the IBM 1620, and a very forgettable group of analog machines, among others. He is now professor of Industrial and Organizational Psychology on the doctoral faculty of Baruch College of the City Univ. of New York, and is president of Lakeview Research, Inc., a consulting firm. His experience with computers of ever-decreasing size and cost provided the premise for this article.

For several weeks last winter, I conducted an informal survey among my colleagues and graduate students, posing the question:

"How would you make use of a small, portable computer, capable of storing and retrieving information, performing mathematical calculations, and making logical decisions?" About 15% of my respondents stated that they would use the computer's mathematical capability for assistance in job related calculations, statistics, engineering, etc. Another 5% proposed to use it in some non-job related fashion, including as a paper weight, to figure the odds at the racetrack, etc.

But the overwhelming majority, nearly 80% of those asked, would make primary use of the information storage function, largely as a memory aid. They would use it to store and recall names, addresses, phone numbers, and birthdays. They would load it with the factual content of course work or job related information, for retrieval as needed.

This last proposed use was expressed with great depth of feeling since the question was posed immediately prior to college examinations; a time in the life of any member of a college community in which information storage and subsequent retrieval becomes a matter of great import.

A Matter of Education

After reviewing the results of my informal survey, I began to wonder at the feasibility of this last use. Just how much information storage is required of a college student?

At a first approximation we may be able to estimate the information storage requirement by assuming that a college education represents the accumulated sum of all the assigned course reading over a period of four years.

Let us take Paul Samuelson's *Economics* as a representative textbook. It contains 800 pages, 40 lines per page, with 15 words or 80 character spaces per line, for a total of 480,000 words or 2,560,000 characters.

If the typical requirement is two such books per course per semester, a college education represents 64 books; a total of 3.1×10^7 words or 1.64×10^8 characters. Coded in 7-bit ASCII format, a college education therefore represents 1.15×10^9 bits of information.

Now the current state of the art in solid state computer memory permits an information packing density of 6 $mils^3$ per bit with integrated injection logic (I^2L). Neglecting packaging materials and leads, this comes to about 1.67×10^8 bits per cubic inch of active volume.

A college education therefore represents 6.88 cubic inches of state of the art storage, about the volume of a king size cigarette flip-top box.

A common concern in my survey was the manner in which communication with the hypothesized computer would be accomplished. Most such communication requires the learning of a mechanical skill, keyboard entry, and a special programming language. My respondents felt that the computer would be of limited usefulness unless they could communicate to the computer as they would to another person in a natural spoken language and receive a similar auditory response.

Let's look at the state of the art in this. Several years ago, IBM reported 92+% accuracy over a wide range of subjects with a phoneme decoder about the size of a shoe box for input. I suspect the size is smaller and the accuracy is higher today. Also, English-like query languages for data base access are in active development in software houses throughout the country.

For output, synthesizers have been around for some time and are in commercial use in stock quotation devices, calculators, and reading devices for the blind.

Suppose then we approach the input/output problem on a verbal level; the user speaks to the computer, perhaps in a restricted or formalized query language, and receives a

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synthesized speech response. No conceptual breakthroughs are required, merely miniaturization.

But, if we are going to communicate in the spoken word, why bother to encode all the characters of text? Why not code phonemes instead? This will cut the storage volume required by almost half.* Thus the information content of a college education could be stored in 3.7 cubic inches.

This volume is based on technology representing the current commercial state of the art. Within the last few months, a major semiconductor manufacturer has started preproduction runs of magnetic bubble static memories with storage capabilities of over 92,000 bits per chip. This permits an increase in information storage density of 22.5 times over the (I^2L) or CMOS memories used for the previous calculations. These and other new nonvolatile memories use little or no power in the resting mode. If we take advantage of this newest technology, a college education can be reduced to 0.17 $inch^3$ or about 3 cubic centimeters.

As Easy as Pulling Teeth

This size is small enough to be conveniently implanted in the body, perhaps as a dental inlay or in the space made available by extracting a nonfunctional wisdom tooth.

I wouldn't want anyone to judge this argument on the inlay idea, but the mouth is, in fact, an almost ideal environment. We tolerate foreign bodies in the mouth quite well. Virtually everyone in the audience has a filling or an inlay, a false tooth, or a piece of bridgework. The mouth is temperature controlled and serves as an effective heat sink. This location for the computer facilitates input/output communication, a piezoelectric crystal picking up the vibrations of speech and responding via bone conduction to the ear.

Indeed the saliva could act as an electrolyte for a wet cell which generates the power for operation. The only unusual design requirements are that the device be waterproof, shockproof, and nontoxic.

Thus obtaining the information incidental to a college education could be achieved as easily as pulling teeth — and in the same professional office.

But, you may well ask, despite the fact that the student receives his diploma with his dental bill, is this really an education?

The answer is an unequivocal NO — and an unfortunate YES.

It is really no more of an education than handing a student an armful of textbooks and granting him his degree; but, the latter is a fair characterization of present educational practices, and the inlay wouldn't be much worse.

Education, as we conceive of it today, may be considered a communications channel which conveys information from the printed page to the gray matter of the brain. Since the communication channel has such a low data rate and the brain's retention process is so inefficient, a prodigious amount of time must be spent in information transfer. If we assume that a student spends 40 hours a week for 9 months of each academic year reading the 3.1×10^7 words representing a college education, he has a data input rate of approximately 58 bits/second.

Judging by the typical performance on examinations, only about 1/10 of this information is retained, resulting in an effective transmission rate of six bits/second from the printed page to the brain.

An oft-spoken criticism of contemporary education is that so much time is spent in the accumulation of information, that very little time is available to explore the use of that information. The direct implantation of *data* would solve that problem in a single stroke and could allow the educational process to direct itself to the integration and understanding of information rather than the accumulation of facts. In this respect the personal computer represents a potential technological breakthrough in education roughly on a par with the invention of moveable type.

No One Reads the Sky Anymore

Aside from purely pedagogical considerations, the economic implications of a personal computer are staggering. As a simplified example, consider my son's grade school. Our local school district spends nearly $1,700/year/schoolchild. Approximately 15% of the educational time is directed to instruction in basic mathematics, largely rote learning of arithmetic. By the time the child has completed the fifth grade, the school system, and we the taxpayers, have spent $1,275 to teach the child to add, subtract, multiply, and divide.

Now you and I know that we can buy the same skills conveniently packaged in the form of a pocket calculator at the local drug store for $9.98. Furthermore, the calculator never makes a mistake — but my son often does.

When I expressed my misgivings at a teacher's conference about spending so much valuable educational time and money on rote learning an easily mechanizable skill, I was greeted with expressions of shock and disbelief. "How can anyone," I was asked, "function in our society without a thorough mastery of arithmetic?"

Yet, when I asked the time everyone in the room looked at his or her watch. No one glanced out of the window to ascertain the position of the sun in the sky. Not so long ago, however, the ability to tell time by the position of the heavenly bodies was also one of the marks of an educated person. But since the personal timepiece evolved into a ubiquitous artifact, telling time by the sky has been deemed a skill appropriate only for Boy Scouts, along with finding north by the moss on the trees, and building a fire by rubbing two sticks together.

In due time, perhaps in the next year or two, Mickey Mouse on my son's wristwatch may learn to count on his fingers as well as tell time by moving his hands. So too, after a somewhat longer period, the personal computer may become a ubiquitous artifact, a part of the natural scheme of things.

The overall consequence of this eventuality may well be a change in our normal method of intellectual functioning. The most immediate is the one we have already discussed, providing the data bank of education at all levels of schooling — not the methodology mind you, but the data.

Instant Retraining

Another, and perhaps equally important, consequence will be the possibility of instantly changing or updating learned bodies of occupationally relevant data.

It has been estimated that the half-life of a technology based job or education is about five years. That is, five years after learning a job or leaving school, half of what you have learned is obsolete. Retraining our adult work force has become an increasingly important problem. If present trends continue, a worker may well have to be retrained four to five times during his working life, with all of the lost time and emotional trauma that such

---

*Assuming 4 phonemes/word, the 3.1×10^7 words = 1.24×10^8 phonemes. The (32) phonemes of English can be encoded by a 5-bit code. Thus the information content is 6.2×10^8 bits equivalent to 3.7 in^3.

drastic dislocation in life involves.

With the implantable computer it may ultimately be possible to change one's occupation with every visit to the dentist. Perhaps even do-it-yourself preprogrammed memories might be made available in such selected specialties as law and medicine as a substitute for post-graduate education.

Along a similar line, the courtroom lawyer might contain his law library in his molar, the tax accountant in his bicuspid. What a godsend for the doctoral student facing oral examinations!

On a less esoteric level, the individual contemplating an overseas trip may eschew Berlitz for an implanted foreign language dictionary. Imagine the effect of acquiring 10,000 words of Chinese in a two hour layover in Hong Kong!

The social implications of the implanted computer are equally as profound. If costs can be kept reasonable, as they probably will be judging by the price/performance manufacturing learning curve of pocket calculators and digital watches, the computer might well serve as a social equalizer divorcing access to data from income level. Note that human performance is still limited by intelligence and by the ability to use data itself.

When I first started this little paper my tongue was firmly lodged in my cheek. But, come to think of it, everything I have suggested is either within the state of the art today or is likely to be so before this decade is out. The technology is here and the economic impetus is positive. Indeed, the personal computer capability suggested is *not* the ultimate individual system but rather an interim step. The ultimate computer might well be the size of a grain of sand implanted in the brain at birth and as accessible to the brain as any other neuron.

With the implantable computer it may ultimately be possible to change one's occupation with every visit to the dentist.

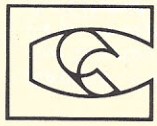
At the moment I would say that such a device was a practical impossibility. Not a conceptual impossibility, mind you, but a practical one. I would be willing to bet, however, that perhaps my child, or certainly my grandchild will be spared the difficulty of rote learning the data of a college education by a man-made, aptly named, wisdom tooth. Okay, if not a tooth, then a locket or a wrist computer.

Now I'm not seriously recommending that IBM should try to corner the market on dental supplies or that Intel should apply for FDA approval of its memories, but rather that the data processing community should become aware of the long range implications of size and price reduction of computing machinery. We are in the earliest stages of a technological revolution which will force us to reevaluate that human attribute, the storage, manipulation, and recall of information, and in consequence, the utility of an educational process that provides that information in a most inefficient way. ■

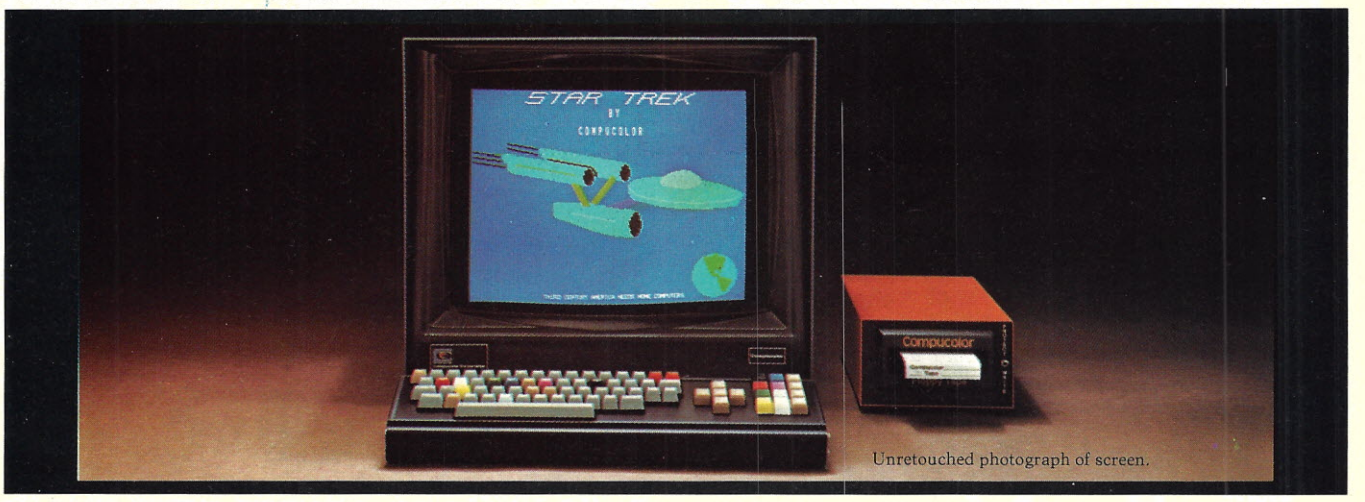
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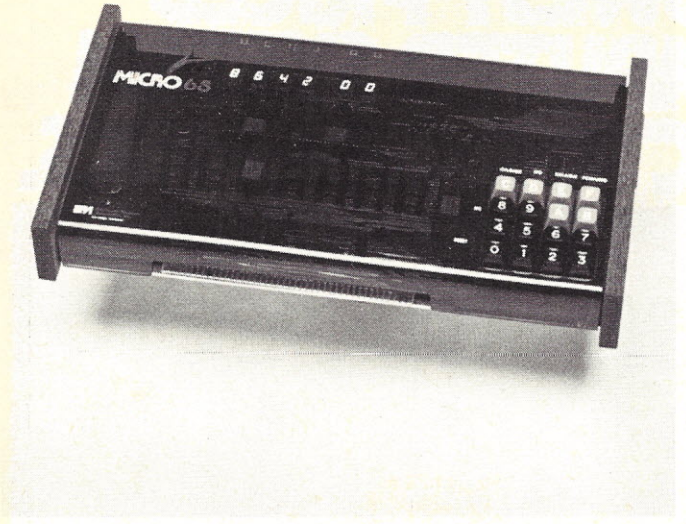
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The Electronic Product Associates Micro-68, a small computer costing about $500. It also needs software to actually do anything. (Courtesy of Electronic Product Associates, San Diego CA)



The IBM 370/168 a large general-purpose computer costing several million dollars. With the proper software, this computer can handle many large tasks. (Courtesy IBM)

Talk Your Computer's Language!

... which level do you need?

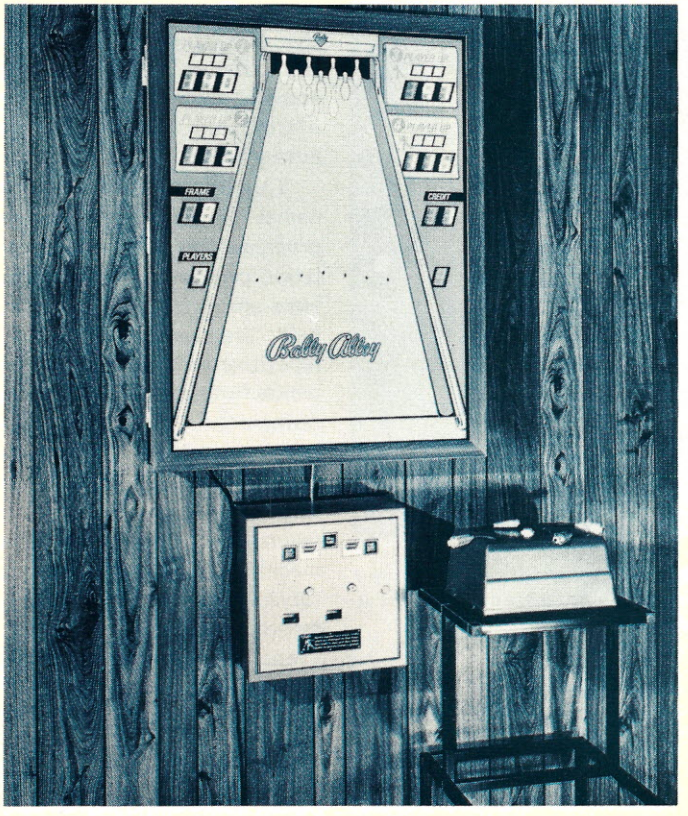
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Rancho Santa Fe CA 92067

It is hard to explain to people that a computer cannot do anything without a program or *software*. Even if the computer costs several million dollars like an IBM 370/168 it still won't do anything all by itself. Surely you cannot expect more from a computer like the Electronic Product Associates Micro-68, that costs only $500. Even the spinning tape reels that represent computers in so many movies cost more than that.

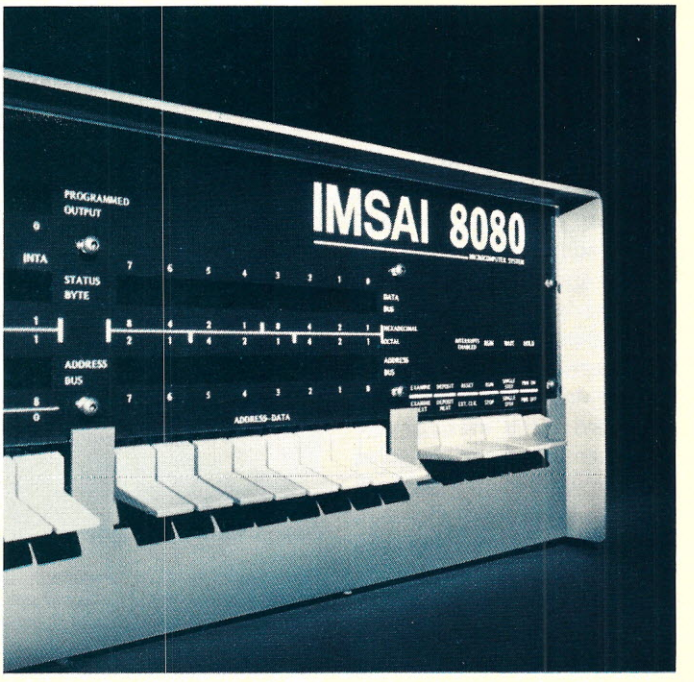
The Software Problem

But how do you write this mysterious program and what does it say? Newcomers to the computer field are often surprised to find that software is the major problem and expense in most systems. How do you write software? How do you get it to run properly? How can you be sure that it really works? These questions are far from solved. After all, programs and programming have only been around for thirty years; we haven't solved many of the problems in disciplines like economics, literature, and history which people have struggled with for thousands of years. But would most people guess that the software involved in an application like the Bally Alley bowling game in the photograph cost thousands of dollars and many months to develop?

In order to use the computer, we must somehow translate the task we want the computer to perform into a series of instructions which it can understand. The computer itself can perform some of the repetitive aspects of the translation if it has programs written for that purpose. We call programs which help us write and run the useful programs *systems software*; the useful programs are *applications software*. However, the more the computer does, the less control the programmer has and the more systems software, memory, and peripherals are necessary. The user must choose between the programming ease and power of high-level languages and the lower cost and greater efficiency of



The Bally Alley Bowling Game, a computer-controlled pinball machine. Software is the major problem and expense in such systems. (Courtesy of Bally Manufacturing Co.)



The IMSAI 8080 Computer. Its panel switches and lights can be used to enter programs in binary. (Courtesy of IMS Manufacturing Co., San Leandro CA)

machine or assembly language.

Talking the Computer's Language

The computer itself only performs certain specified actions in response to the binary patterns which form its instruction set; the manufacturer defines this set as part of the design of the CPU. The instructions generally are rather simple: Add the contents of two registers or shift the contents of a register one place to the left. On the other hand, the tasks the programmer wants to do are much more complex: change a word in a line of text, read data from a cassette, or move a spaceship in a "Space-war" game. These tasks will require many of the simple computer instructions.

The programmer can try to do the entire job without any help from the computer. Of course, this was the original programming method; it involves writing the required sequence of instructions in binary and entering it into the computer memory with switches like the front panel switches on the Imsai 8080 in the photograph. An Intel 8080 program to add two numbers (locations 40 and 41 hexadecimal) and return the result to memory location 42 (hex) would look like this in binary:

```
00111010
01000000
00000000
01000111
00111010
01000001
00000000
10000000
00110010
01000010
00000000
```

Clearly the purpose of such a program is far from obvious to the reader. Furthermore, the entry process is tiresome and most people make a lot of mistakes. Only a person with a perfect memory and strong fingers could enter a long program this way. Of course, the programmer must also verify the entry procedure and somehow find any errors.

Finding errors is difficult since all binary numbers look the same (at least to this observer). Here is the same program as before with one bit wrong. Can you find the mistake? How long did it take?

```
00111010
01000000
00000000
01000111
00111010
00100001
00000000
10000000
00110010
01000010
00000000
```

Getting the Computer to Help

A simple way in which the computer can help is with an octal or hexadecimal monitor. This is a program which takes entries in octal or hexadecimal and converts them into binary. Now the simple addition program is (in hexadecimal):

```
3A
40
00
47
3A
41
00
80
32
42
00
```

At the very least, entering a program in octal or hexadecimal is easier on the eyes and the fingers. Furthermore, finding errors is much simpler. Here's the erroneous program in hexadecimal. Now can you find the mistake?

```
3A
40
00
47
3A
21
00
80
32
42
00
```

However, you must either buy or write the monitor program which does the conversion. Of course, such simple programs are widely available at very low cost. The conversion is a perfect task for a computer which never makes an arithmetic

mistake, looks at the wrong line, forgets to use the right number system, or gets tired of the whole procedure.

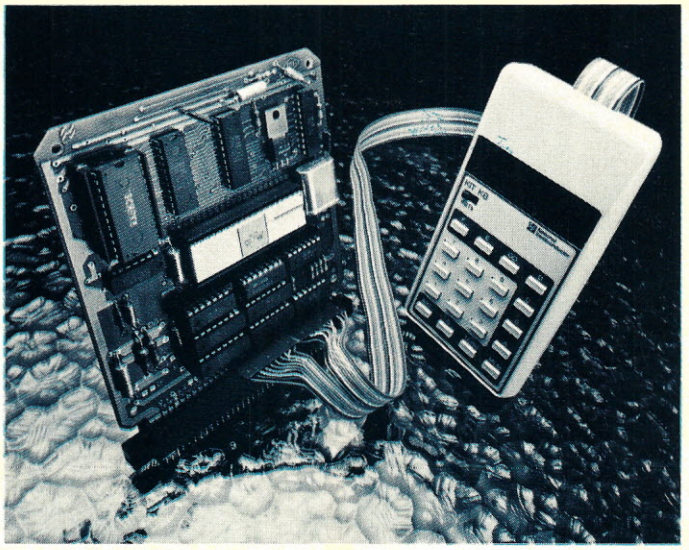
Note that the octal or hexadecimal monitor also requires more complex input and output devices. You will need something that will accept and display the octal or hexadecimal entries like the National SC/MP keyboard kit shown in the photograph. Even a simple device like this keyboard kit is more expensive than a row of switches and a row of lights (that's all you need for binary entry). Each added convenience results in extra costs in memory, programs, peripherals, and other accessories. It is like those bargain car prices they advertise on television; of course, that price does not include "dealer preparation, delivery, tax, license, motor, wheels, seats, doors, etc."

Entering instruction codes directly with no other assistance than that provided by a simple monitor is *machine language programming*. Its advantages are that you can enter programs directly into the computer and that you need very little extra software or memory. Its disadvantages are slowness, inflexibility, lack of documentation or debugging facilities, and complete machine dependence. The same addition program written for a Motorola 6800-based computer like the EPA Micro-68 would be (in hexadecimal):

96
40
9B
41
97
42

Clearly, the programs do not look much alike and neither one tells you very much about what is going on.

Machine language programmers must be very familiar with every aspect of the computers they use. The programmer must know what registers are available and how they can be used, what



The National Semiconductor SC/MP Keyboard Kit. Its keys and displays allow the user to enter programs in hexadecimal. The cost is $95. (Courtesy of National Semiconductor)

effects the instructions have on registers and status flags, what addresses or data each instruction requires, and what limitations the computer has on addressing methods or data length. An Intel 8080 programmer must, for example, remember that the processor cannot add the contents of a memory location directly to the accumulator; you have to move the data to a register. A machine language programmer using either the Intel 8080 or Motorola 6800 must remember whether a particular instruction requires one, two, or three bytes of memory. Most computer users really are not very interested in such distinctions. They want to try a new game, play music, control an amateur radio station, or handle accounts. Few users want to spend their time becoming experts in manipulating registers and status flags. To most, this is not a very interesting or useful pastime.

Calling Things by Name

The programmer can improve the situation a little by assigning names to instructions, addresses, and data. This procedure makes programs more comprehensible and easier to debug but the programmer must keep the track of all the names and eventually translate them into their binary or hexadecimal equivalents. The manufacturer provides a set of names for the instructions and the registers. These names are called *mnemonics* since they are supposed to be easy to remember. The problem is that while some operations have obvious mnemonics (e.g., ADD, SUB, JUMP, OR), others do not. The result is mnemonics like WMP, PCHL, and even SOB (try to guess what that means!) The programmer must assign names to addresses and data and will soon discover why the manufacturer has difficulty providing sensible names.

The Intel 8080 addition program using appropriate names is:

```
LDA NUM1
MOV B, A
LDA NUM2
ADD B
STA RESLT
```

This surely makes a little more sense than the binary or hexadecimal versions. The reader can differentiate between instructions, data, and addresses and get some idea of what the program is doing. Of course, the programmer must still translate the program into the form which the computer understands. Remember that only the programmer gains from this change; the computer actually likes (and will only ultimately execute) the binary form.

This improved form using names is *assembly language programming* and the translation process is an *assembly*. Here again, the computer can help; the assembly is another repetitive series of operations which form an ideal task for a computer. The program which does this job is an *assembler*. It takes the assembly language program (*source code*) and produces a machine language program (*object code*). It translates mnemonics into binary codes, keeps tables of user-assigned names, and can do a lot of additional housekeeping as well. Note that the assembler does not care whether the names mean anything or not; it will handle WMP or SOB just as well as ADD, LOAD, or AND. Of course, an assembler is a much more complex program than a hexadecimal monitor.

The advantages of assembly language programming are obvious: Programs are easier to write, understand, enter into the computer, and debug. The programs are still different for each computer but not as different as in the machine language case. The Motorola 6800 version of the addition program, for example, is:

```
LDAA NUM1
ADDA NUM2
STAA RESLT
```

The assembly language programs are certainly far more alike than the machine language programs. The assembler also will automatically make each instruction the proper length and immediately inform the programmer of errors in syntax. Some assemblers can create programs which the user can place anywhere in memory; they may also perform various code conversions, permit simple entry

of tables and messages, provide shorthand forms for common instruction sequences, and even do some arithmetic. As usual, the more the assembler does, the more it costs and the more memory it requires.

The most obvious disadvantage of assembly language programming is the need for an assembler. Not only do assemblers cost money (hand assembly is impossible for anything but short programs), but they also require extra memory and peripherals. A typical assembler will occupy several thousand words of memory; a printer is necessary to make listings and a cassette or paper tape reader to enter user programs and the assembler itself. Now you will find you need a peripheral like the $1,000 standard teletypewriter shown in the photograph; it combines a typewriter-like keyboard with a paper tape reader and punch. Furthermore, the assembler has its own rules which the programmer must learn and error messages which the programmer must decipher.

The assembly language programmer still has the problem of describing a task in the computer's language, i.e., in terms of the basic instruction set. Complex operations will still result in many simple instructions. The programmer must learn and remember all the peculiarities of a particular computer. The final program will be difficult to understand without a great deal of documentation and unusable on any other computer.

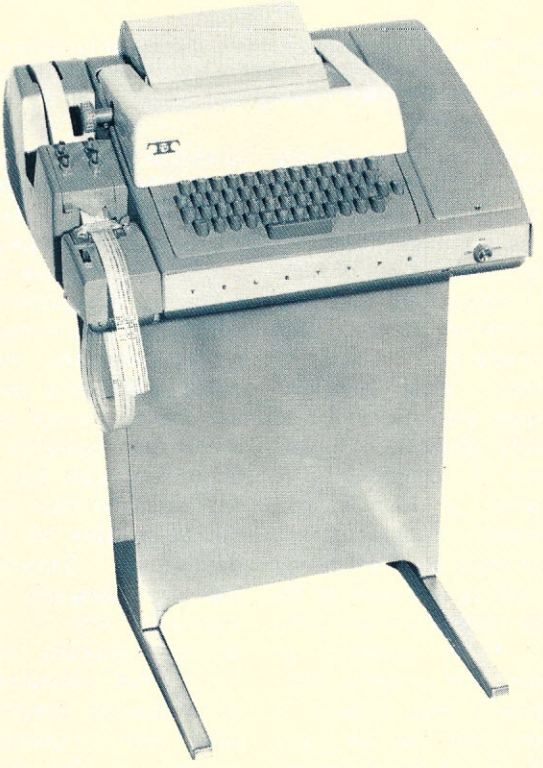
Making the Computer Talk Your Language

Of course, the ideal procedure would be for the computer to understand an ordinary written description of the task. But human languages are far too complex for computers. The meaning of words is imprecise and often depends on their context or on the origin or occupation of the writer. Computer translations of natural languages are seldom successful for this reason. The problem is to find a compromise which both the user and the computer can understand.

The *high-level (procedure-oriented) language* is a solution to this problem. High-level languages are designed so that a particular type of operation can be easily formulated and performed by a computer. A program called a *compiler* translates the high-level language program into an actual machine language program. Unlike assembly language, each statement in a high-level language will result in many machine language instructions.

A recent roster of high-level programming languages, although limited to those in more than local use in the United States, contains 167 entries. This roster does not include many new languages developed specifically for small computers. Some of the high-level languages are general-purpose; others are specifically intended for such applications as engineering design, numerically controlled machine tools, transportation networks, simulation, graphs, animation, computer-aided instruction, systems software, string handling, test generation, economics, and circuit design. Among the ones you may have heard of (in alphabetical order) are:

1. ALGOL (Algorithmic Language). A general-purpose language which is popular with theoreticians. Also widely used in Europe.
2. APL (A Programming Language). A powerful language with an unusual character set which can operate directly on entire string and arrays.
3. BASIC (Beginner's All-Purpose Symbolic Instruction Code). A simple language developed for solving numerical problems. Widely used for instructional, business and entertainment programs in professional and hobbyist applications.
4. COBOL (Common Business Oriented Language). An English-like language widely used in business data processing.
5. FORTRAN (Formula Translation language). A language originally designed for scientific applications, but now used in almost every field. The first and most widely used high-level language.
6. LISP (List Processing). A list processing language.
7. PASCAL. An extended version of ALGOL designed for structured programming and systems software.
8. PL/I (Programming Language I). A general-purpose language which combines many of the features of ALGOL, COBOL, and FORTRAN.
9. SNOBOL. A string processing language.



The Teletype Corporation ASR-33 teletypewriter. This widely used device allows the user to enter assembly language programs from the keyboard or paper tape reader. The cost is around $1,000. (Courtesy of Teletype Corporation)

The existence of so many high-level languages clearly means that no single one has proved to be suitable for all tasks. Even more languages have appeared and disappeared. Fig. 1 tracks the rough history of the major languages starting with the development of FORTRAN in the early 1950s.

Of course, only a few of the languages are really in everyday use. The most common are FORTRAN for scientific problems, COBOL for business problems, and BASIC for instructional systems. Programs in high-level languages are much shorter and simpler than programs in assembly or machine language. For example, the addition program in FORTRAN becomes the single statement

```
RESLT = NUM1 + NUM2
```

Surely that program is easier to write and to understand than any of the previous forms.

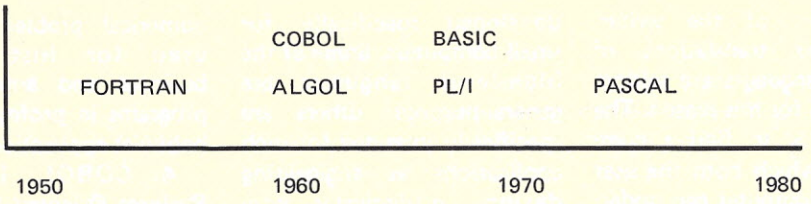
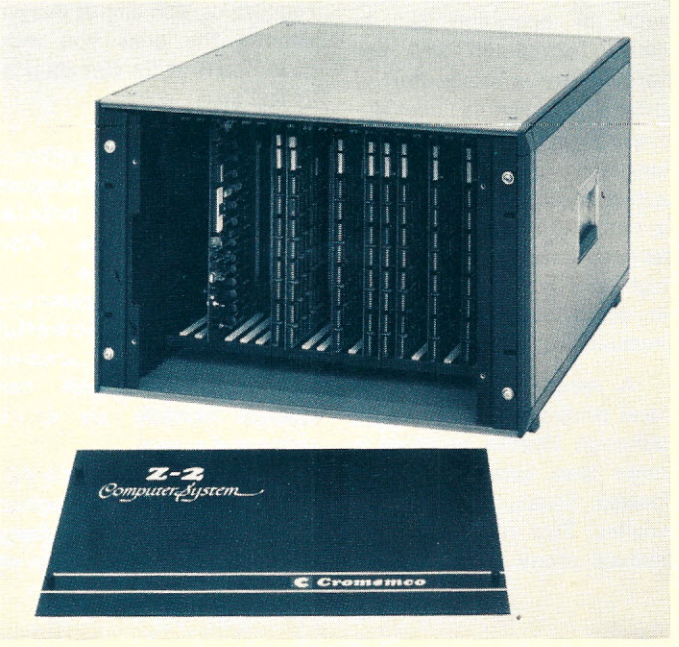


Fig. 1. A time history of common computer languages. FORTRAN is both the oldest and most widely used of these common high-level languages. PASCAL is a relative newcomer which computer users should be aware of.

Talking at a High Level

The high-level language program closely resembles the steps which a person in a particular field would normally use to describe the solution to a problem. The program does not mention the registers, flags, and addresses which the compiler will use to implement the statements. Users can formulate solutions in their own terms and let the compiler handle the details. A FORTRAN program, for example, is very similar to the algebraic formulation of a scientific or engineering problem while a COBOL program handles the large data files and complex reporting procedures that are typical of business problems. The designer must choose the proper language — COBOL would clearly be awkward for solving mathematical equations while a special language for complex equations would not handle a payroll very well.

The advantages of high-level languages are that programs are shorter, easier to write and debug, and more comprehensible. Furthermore, the programmer does not have to worry about (or learn) the internal workings or the instruction set of a particular computer. The resulting programs are portable (they can run on any computer that has a compiler for the language). In the case of common languages that have widely agreed-upon standards, the programmer may even be able to find old programs that solve a particular problem. There are lots of FORTRAN, COBOL, and BASIC programs in files, libraries, and magazines.



The Cromemco Z-2 Computer, a system capable of handling high-level languages if you add enough memory and peripherals. (Courtesy of Cromemco, Inc., Mountain View CA)

The disadvantages of high-level languages are that they often produce programs that run slowly and use a lot of memory. Most high-level languages are only suited to particular applications and all require a compiler. The compiler is like a real language translator; its awkwardness and inefficiency have the same causes as the strange translations one often finds from Japanese or German. The compiler itself occupies a large amount of memory and may be fairly expensive. Most computers capable of supporting high-level languages will be large systems with many extras like the Cromemco Z-2 system shown in the photograph.

High-level languages also allow many tradeoffs. Some compilers can produce faster and shorter machine language programs by examining the context in which statements appear. However, these so-called optimizing compilers use more memory and run slower than regular compilers. Some languages are simpler and easier to learn but may not be suitable for complex applications. Sometimes a high-level language is not translated into a machine language program and then run; instead, a program called an interpreter simply translates each statement and executes it. This procedure uses less memory and can easily be made interactive but does not result in efficient programs and means that the translation must be performed every time the user runs the original program.

Choosing a Level

Which way is the best? The choice depends on the programmer and the task. High-level languages are easier to use and provide more comprehensible programs. Assembly and machine language allow the programmer to manipulate the computer very cleverly; this often results in much faster and shorter programs. BASIC, for example, is well-suited to games, editors, calculators, interactive programs, and instructional uses. Assembly language is often better for I/O handlers, operating systems, real-time applications, and other systems programs. Even if you do not normally write assembly language programs, you may want to learn a little about assembly language. That way you will know how it works and you will be able to take advantage of other people's assembly language programs. But high-level languages are clearly the way to go for most large user programs; writing, debugging, and testing the programs are all much simpler. ■

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A PET For Every Home

... a look at the Commodore PET 2001

Sheila Clarke
P.O. Box 430
Glendale CA 91206

As far back as two years ago it was predicted by a few that someone would produce a computer system, designed to sit alongside your calculator, or TV and stereo. Commodore Business Machines of Palo Alto, California has done just that. They're aiming the PET 2001 at every housewife, small business person, and kid on the block. The PET (Personal Electronic Transactor), Commodore claims, is the first mass-produced turnkey computer to be manufactured, that can be used by anyone from six-year-olds to fine instrument design engineers. The term "home computing" is now being redefined by Commodore to include consumers beyond the range of heretofore hobbyists.

There is certainly not enough time for any author or magazine to check out every single new computer that pops up on the horizon. But two things sent us up to Palo Alto for a first-hand look. One was the low price (how can they do that?!) and the other was the mass market appeal (what would I do with a computer, anyway?).

Ready to run at the flip of a switch, the PET 2001 will be priced in the $600 range. The complete system integrates a 9 inch video display, ASCII and numeric keyboards on one panel, cassette storage and BASIC software. The 6502 based machine has been given a specially designed interface based on the IEEE-488 bus standard. Resident memory totals 12K. Details on the PET specifications and software are discussed further on, but first let's take a look at Commodore's thinking with regard to PET's future.

Arnold Karush, Systems Sales Manager for Commodore, has been a programmer by trade. Formerly marketing manager at Imsai, Arnie moved over to Commodore in early April to handle the newly formed division for the PET. Chuck Peddle, designer of PET, hailed from MOS Technology (KIM manufacturers) where he had designed the 6502 chip. Both gentlemen responded to the question regarding the low pricing of PET by explaining that Commodore is a "vertically integrated company," meaning they now own MOS Technology which makes the most expensive ingredients at rock bottom pricing. Some of those ingredients include semiconductors and the 6502 chip. What Commodore can't produce, they can afford to purchase in large quantities wherever in the world the components are least expensive. Says Arnie Karush, "Commodore manufactures all the most costly components itself. Also it is taking a mass production view. No one, not even IBM has yet mass-produced a computer. The pricing is structured to promote sufficient profits, and at the same time, produce sufficient sales to support the product at this low price. We could sell it for $1,000 and still sell a lot."

Chuck Peddle explains further, "We feel prices can be controlled. The most anti-inflationary thing going is semiconductor technology. Commodore purchased that capability when they bought MOS Technology. We decided the best utilization of their capability was with our known retail service and an international manufacturing and marketing viewpoint. They (MOS Technology) felt the best place to put their money was in personal computing in a way that would let them maximize their semiconductor orientation."

Specifications

The entire unit weighs forty-four pounds and measures 16½" wide by 18½" deep and 14" high. Memory includes an 8K BASIC interpreter and a 4K operating system, with optional possibilities for expansion to 32K. The video display has unusually good resolution in a 9" screen. It features a 1000 character display in 40 columns by 25 lines. The 8 x 8 dot matrix makes for fine continuous graphics and graph plotting, as well as automatic scrolling and blinking cursor. Graphics capability also includes reverse field on all characters.

The keyboard has 64 ASCII upper and lower case characters scrunched into a smaller area than a normal keyboard, but arranged identically to a typewriter. The upper case characters provide the pseudo-graphics capability, including playing card symbols. Alongside is the numerical keyboard arranged calculator style. Limited editing functions provide insertion and deletion, with screen control of clear and erase.

The cassette drive uses standard cassette tapes. Commodore is providing a file management system in BASIC. Some of the programming capabilities include single character input/output with a GET command, strings, integers and multiple dimension arrays. The PEEK and POKE commands permit one to program in assembly language using subroutines. Commodore feels their BASIC expands the capabilities of current BASICs by claiming it's 20% faster, and uses high precision with ten significant digits.

Peripherals

The IEEE-488 interface standard has several important implications. Among them is the high quality of communication capable between the PET and peripherals. No, there are no peripherals yet available for the computer. But Commodore projects that the first of



Commodore Business Machines' PET (Personal Electronic Transactor) Computer.

several will be available within the next six to nine months. It will be a printer with formatting capabilities, followed by an intelligent floppy disk system. All peripherals will connect to the bus in daisy-chain fashion. Each will be individually addressable. Pricing for peripherals is anticipated to be as relatively low as the PET is to competitive micros.

Now, all you home-brew enterpreneurs stop tugging on your earlobes and pay attention: Commodore is inviting outside designs of special features and functions to be submitted for purchase and inclusion in the PET package. Your invention must be more than theory and hypotheses . . . it must be proven. The company is, however, very interested in encouraging outside innovation and invites you to submit yours directly to Commodore, PET Division, 901 California Ave., Palo Alto CA 94304.

Chuck Peddle talked about the design possibilities for future peripherals, saying, "We've done some things in the PET that are not obvious. The cassette, though a standard audio drive, has been dramatically simplified. Commodore designed all its electronics. We look at a mechanism or a peripheral and try to figure out how to put smarts into it. For instance, the floppy disk will probably have three processors. We'll be using micros to handle a lot that other manufacturers do not."

IEEE-488 Bus Standard

The PET departs from the so-called Altair bus standard by using the IEEE-488 bus. Until now, as it was explained, the only way to obtain interfacing for this bus was through very few manufacturers, like Hewlett/Packard, and at great expense. Arrival of the PET particularly excited instrumentation houses across the country, according to Karush, because most of them require the IEEE bus to computerize their instruments. "Several years ago instrumentation houses predicted that ultimately all instruments would be connected to computers. Very expensively." So, he continued, designers got together and under the IEEE banner, developed the IEEE-488 standard interface. It has been published and is now accepted by all instrumentation houses. Most have the capability, but in a black box only. Until now, no one has offered a computer using this standard.

Software

The mass consumer market is not made up of programmers. So heavy emphasis has been placed on development of a wide variety of software packages. Many programs, several on one cassette, will be available at the time the PET goes on the market. Some include financial management, home accounting, real estate, and games (of course!). About 40 volumes, or cassettes of programs are anticipated to be available in September.

Now you software types pay special attention. Commodore is going into the software publishing business. Authors will now have a market for their 6502 software because Commodore is particularly interested in stimulating a market for your talents. Software writers who have fully debugged, tested and documented programs for the PET may submit them to Commodore for purchase or royalty payment. Anyone interested in participating may contact Ms. Terry Brock at Commodore in Palo Alto. Arnie Karush added that if



Chuck Peddle, Pet's designer at Commodore, and 6502 chip designer while at MOS Technology, plans to put "smarts" into every peripheral to be designed for the PET.



Arnold Karush, Commodore's Systems Sales Manager, predicts spectacular first year sales for PET. He confidently speculates that Commodore's mass-produced computer will take the world's population by storm.

Commodore sees that programmers are clamoring for assembly language, they'll develop it.

Who Will Buy a PET?

Can't you see it now: "Every Man Who's His Own Man Owns a Personal Computer" headlined in a *Playboy* Magazine ad. It's coming. Sure, you can order a PET directly from Commodore. More conveniently, you should be able to walk into your nearest computer store and buy one off the shelf. But wouldn't it be a knockout to see it on the shelf of a large department store? That's coming too. At this writing Commodore was still negotiating with a specific retailer, but by now you can check out the advertising in your local newspaper or computer magazine, or perhaps walk into a nearby Sears or Montgomery Ward and see it on the shelf in the business machines department. Karush speculates, "We've concentrated our marketing target on women, but it really applies to men too. If we put an ad in *Playboy* Magazine for instance, or *Newsweek*, or *Business Week* showing a personal computer . . . "

Recent experience with non-hobbyist reaction to seeing a computer in our homes has been of puzzlement and dismay, even awe. When asked how Commodore expects to overcome public resistence to the negative image of computers, Chuck Peddle expressed a sureness that when housewives and working mothers see how simplified their lives, and challenged their minds can become with the addition of a computer, how can they resist?

As Karush puts it, "So far most computer purchasers have been 99% male. If the average man wants to spend $600 for a computer, he's going to have to justify the expense to his wife. So we've taken a look at how a computer may serve that segment (women) of the population. Bridge, for instance, is a complex game that can be brushed up on with the computer before playing with friends (and making a fool of yourself). Or some who have a good educational background and have become bored watching soap operas, have an opportunity to learn something new and challenging. Like programming." Other obvious applications are checkbook and tax record keeping, or menu planning.

Small businesses can use the PET when the printer becomes available. Kids can play games, then when sufficiently hooked, can learn to program. Devices are expected to be available to help the PET handle such functions in the home as energy conservation, control of appliances, and security systems control.

The PET is not yet optimized for broad business applications. But it can now aid, say, an orthodontist in computing the angles for putting braces on someone's teeth, or compute three-dimensional geometry if you're a bridge (not dental) designer. You could compute stress analysis and do bar graphics. Now. It's a great way to get a $600 computer to do what it's taken a $3,000 computer to do.

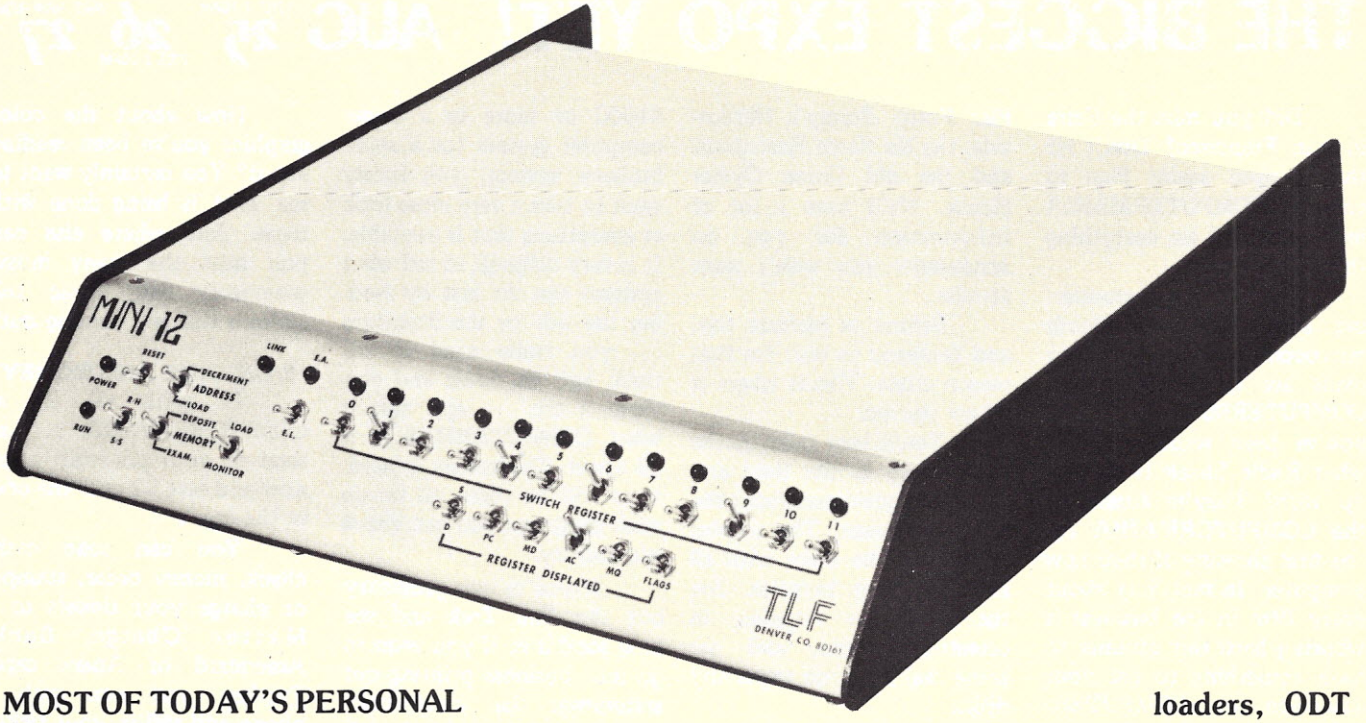
But can it all be done when the PET is available in September? No, unless the software volumes are purchased separately, provided they've been developed by that time. Some will definitely be available. Projections are that a single cassette package will come with the PET, containing tutorial programs. Additional volumes can probably be purchased for around $10 to $20.

What About Hobbyists?

Karush believes that many hobbyists do not have a CRT, or a good BASIC, or a way to load BASIC. If they do, they don't have a good way to get it up and running. Or they don't have graphics capability. In any event Commodore is not concerned with trying to replace 20,000 or so existing home computers. "If we didn't replace any of these, we'd hardly notice it in terms of the overall numbers."

Commodore is betting that their PET will be the forerunner of a whole family of computers. Nobody has yet proven that you can sell 100,000 computers in a year. Commodore will be the first to try. ■

Why buy a micro, when you can buy a mini for less!



MOST OF TODAY'S PERSONAL COMPUTERS are microcomputers. Compared to our minicomputer they are slow and expensive.

Our mini "the MINI 12™" has been around for three years. We've been steadily selling it to industrial customers who have proven its reliability. Only recently have we paid much attention to the personal computing market. We've discovered that our computer is simply better, and most interestingly, LESS EXPENSIVE.

NONE OF THE MICROCOMPUTERS can offer you the range of software available to the MINI 12. Compatibility with the most popular minicomputer, DEC's PDP-8E, gives you a vast library of programs. You will also be pleasantly surprised when you experience the speed and sophistication of our EXTENDED BASIC compiler, or FORTRAN, ALGOL and FOCAL.

Unlike today's microcomputers, our Mini 12 is fully software supported by an advanced operating system, including...file handling text editor, symbolic assembler, loaders, ODT (octal debugging technique), batch processor, and system utilities.

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Because we want you to have the pleasure of using your minicomputer right away, our MINI 12 comes fully assembled, debugged and ready to plug in. It includes a full front panel, controller for eight digital tape drives, and built-in serial interface plus other technical niceties like a binary loader and monitor bootstrap in ROM memory.

Frankly, when compared with microcomputers, we're surprised at how good a deal we are. Write... or better yet, give us a call @303-794-1634 and let us help you get it all together!

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COMPUTERMANIA T.M.

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Did you miss the Faire in San Francisco? Don't let that happen again! Plan to come to COMPUTERMANIA in Boston and see everything there is to see.

Have you been wondering about the new Heath microcomputer system? The plans are to debut this at COMPUTERMANIA. Maybe you've been wanting to see what Radio Shack is coming up with? They're aiming at the COMPUTERMANIA for the first showing of their new computer. In fact, just about every firm in the business is working hard this summer to have something to get your attention at COMPUTERMANIA.

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Unlike other cities, Boston is worth a visit in its own right . . . the Pier is just between two of the most famous Boston restaurants and across the street from two others . . . Anthony's Pier Four, Jimmy's Harborside, the No Name Restaurant and the old Union Oyster House. We'll have a lot of information for you on restaurants you won't want to miss.

Boston is historic too, and fantastic to visit for that reason alone. This is where it all got started.

You'll hear talks by the top people in the field and get to ask questions about the new equipment. The surplus people will be there with all sorts of great bargains. See the latest in floppies, in cassette systems, and get some real deals on tapes and disks.

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In addition to the nearby famous restaurants (some very reasonable in price) there will be outstanding food available at COMPUTERMANIA . . . arrangements have been made for Mexican food, for Chinese food, etc . . . in addition to the usual pizza and hot dogs. You'll have fun.

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Before you invest $1000 or more in a home computer system (or a small business system) you surely want to take a very close look at everything that is available. It is very difficult to tell what systems can do just by reading the ads or the literature . . . you really need to see them and sit down and give them a try . . . and this is what COMPUTERMANIA is all about. The newest in hardware will be there, all set up with programs you can check out and try.

If you're into games try out the Star Trek and see how good it is. If you want to go into business printing out statements for local businesses, see what kind of a job the systems will do with that. The people who have designed and built the systems will be there so you can ask them questions . . . and many of them will be putting on illustrated talks about their systems.

How good are some of the new printers? You can only tell if you see them at work. How fast (or slow) are the systems? You can tell a lot more about that by trying them than reading about them. How easy are some of the new keyboards to use?

How about the color graphics you've been reading about? You certainly want to see what is being done with these. And where else can you hear the many music generators and music I/O systems that are coming out?

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KB 9/77

We Have GOOD NEWS and BAD NEWS

The good news is that you can now add any S-100 bus compatible component to The VERSATILE CRT.

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But there's more than meets the eye. What you can't see is the mainframe which is a 10-slot plexiglass card rack. Or its fully shielded motherboard with 10 spaces provided for sockets (2 sockets are already included for you). Or the heavy duty filtered power supply and 75 CFM cooling fan. Or the power switch and cord on the rear panel. Or the space available for a floppy disk system. Or the expansion capabilities on the back panel for the addition of sockets.

You'll receive The VERSATILE CRT fully assembled with a 90-day warranty, about 20 days after we get your order. Or you can buy one at your nearest dealer. Dealers can have super fast delivery from stock to 20 days. You'll also receive complete documentation and operating manual. Total price for The VERSATILE CRT is $699.95.

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Compact and Expandable, The VERSATILE CRT lets you do it your own way.



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PUBLISHER'S REMARKS

from page 21

is a very bad time to vacation. The Cape, New Hampshire and Maine all fill right up that weekend. You'll do well to avoid travelling on weekends. Right after COMPUTERMANIA will be ideal, for the weather is still fine and most people have finished their vacations by then.

If you're wandering around southern New Hampshire you might pay a visit to *Kilobaud* – we're easy to find. Turn off Route 93 and go south on Route 128 on the outskirts of Boston. From there you turn north on Route 3 toward Nashua, New Hampshire. If you are even slightly hungry, you'll get off at the first exit, Route 62, and go east for about one mile where you'll see Betty Crocker's Pie Shop on the corner. You won't find more delicious pies anywhere. The food is just average, but the pies are fantastic – I never miss a chance to "pie up" when I'm in the vicinity.

After pie, head back north on Route 3 and exit in New Hampshire at exit 7W. This is Route 101A West. About two miles into this route you'll see the Microcomputer Store on your right – next to Santoro's Pizza. If it's open, stop and say hello to Steve and Dexter – you'll not find two nicer guys. Buy something.

Route 101A turns into 101 as you round the bandstand in the center of Milford. Keep going west. As you come down a long straight stretch into Peterborough the second cross street is Pine Street (on the right ... Powers Bridge Road on the left). Turn right on Pine Street and then into the first driveway on your right – says Wayne Green. We'll be expecting you. You won't believe what you're going to see here. It's a mammoth house

(over 200 years old) filled with people running all over the place ... setting type ... pasting up articles ... proofreading ... etc.

NEW PRODUCTS

from page 10

California speech research firm.

Known as SpeechLab, the system is available in selected computer stores and directly from the manufacturer for $249 in kit form or $299 assembled and tested.

SpeechLab digitizes and extracts data from a speech waveform and applies pattern matching techniques to recognize the vocal input. Uses include computer input, games, research and vocal control.

In addition to Altair bus computers such as Sol, Altair, and Imsai, Speechlab can be used with any computer with the aid of a separate power supply and connector.

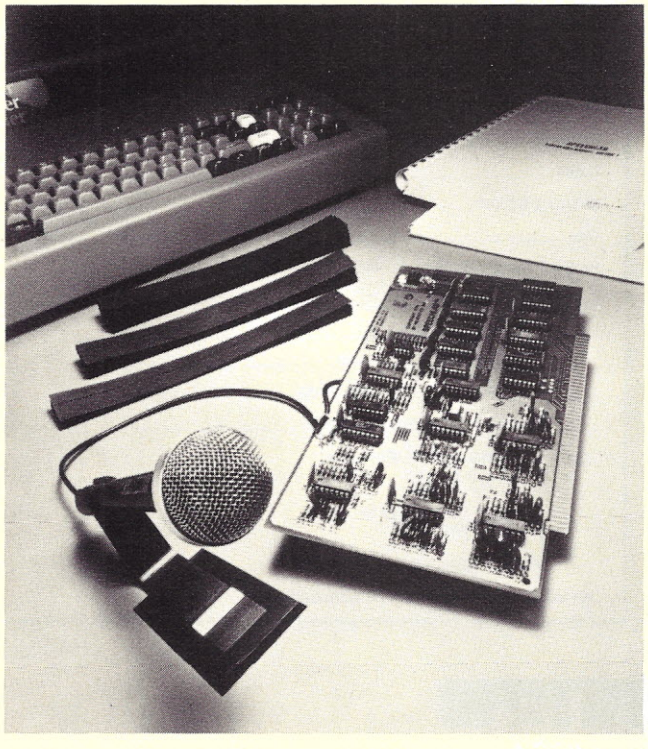
Included in the price is a complete hardware/software system, a 275 page laboratory manual, 95 page hardware manual, high fidelity microphone, and three programs on paper tape. The lab manual is the only introductory volume on speech recognition currently available, according to the manufacturer.

The lab manual includes 35 graded experiments with over 100 tables and graphs. According to the manufacturer, the system can put the user in a position second only to Bell Laboratories with respect to knowledge and use of speech related to computer input.

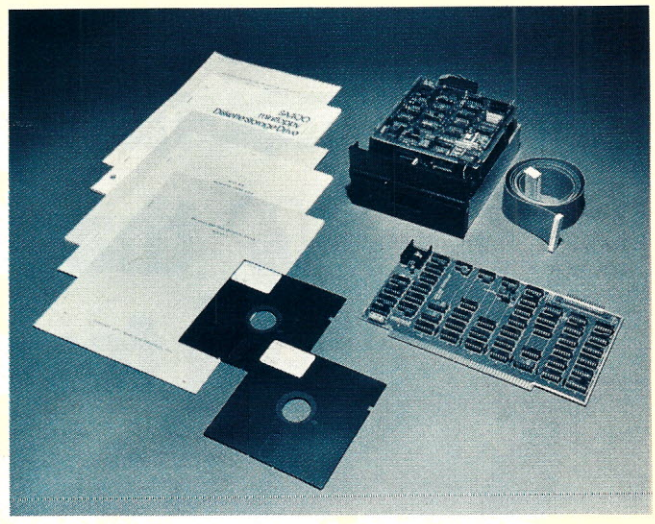
Technically the system features 64 bytes of storage per spoken word and a vocabulary of up to 64 words in memory. Other features include real time response, 95% correct recognition, automatic hardware self-test capability and advanced C-MOS design for low power and reliability.

Software includes SpeechBasic BASIC programming language, assembly language speech recognition program, SpeechBasic plot, correlation, recognition, advanced recognition and hardware self-test programs.

For complete information, address Heuristics, Inc., 900 N. San Antonio Road, Los Altos CA 94022.



Heuristics SpeechLab Voice Input System.



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Sound unbelievable? See the North Star MICRO-DISK SYSTEM at your local computer store. For a high-performance BASIC computing system, all you need is an 8080 or Z80 computer, 16k of memory, a terminal, and the North Star MICRO-DISK SYSTEM. For additional performance, obtain up to a factor of ten increase in BASIC execution speed by also ordering the North Star hardware Floating Point Board (FPB-A). Use of the FPB-A also saves about 1k of memory by eliminating software arithmetic routines.

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N9

NORTH STAR COMPUTERS, INC.
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Couple a Model 500 to a low cost purchased or leased terminal such as the popular ASR-33 teletype for student instruction. The Model 500's BASIC is a perfect instructional language for students. Since the computer's machine code is also accessible, the Model 500 can challenge the advanced student with other optional software such as our interactive Assembler/Editor.

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The Model 500 has eliminated all of the grief of the first generation personal computers. This computer comes fully assembled, tested, and guaranteed.
Most importantly, it is *easy to use* since the BASIC is always there.

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The Model 500 uses Ohio Scientific's standard 48 line bus so that it is fully compatible with our Model 400 kits and Challenger[tm] product lines. Any of thirteen accessory boards including RAM, PROM, parallel, serial, A/D, D/A, cassette, and video graphics can be added as well as peripherals including floppy disks, line printers, color graphics, and more.

The Model 500 is offered here in three forms to meet every application and pocket book.

Specifications

Model 500 Board $298.00

8" x 10" fully assembled board including 6502 microprocessor running at 1MHz, 512 bytes of PROM, 8192 bytes of ROM containing 8K BASIC and 4096 bytes of RAM for user programs. The board contains an ACIA based serial interface which is jumper selectable for RS-232C or 20ma loop at 110, 300, 1200, 2400, or 4800 baud.

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The Model 500 board requires +5 volts at 2 amps, −9 volts at 500ma, an external reset switch, and an ASCII serial terminal for operation.

Model 500-1 $429.00

Fully enclosed 500 board with power supply, reset switch, and two 25 pin EIA standard terminal connectors for loop through operation. The 500-1 is 12" x 15" x 4".

Model 500-8 $629.00

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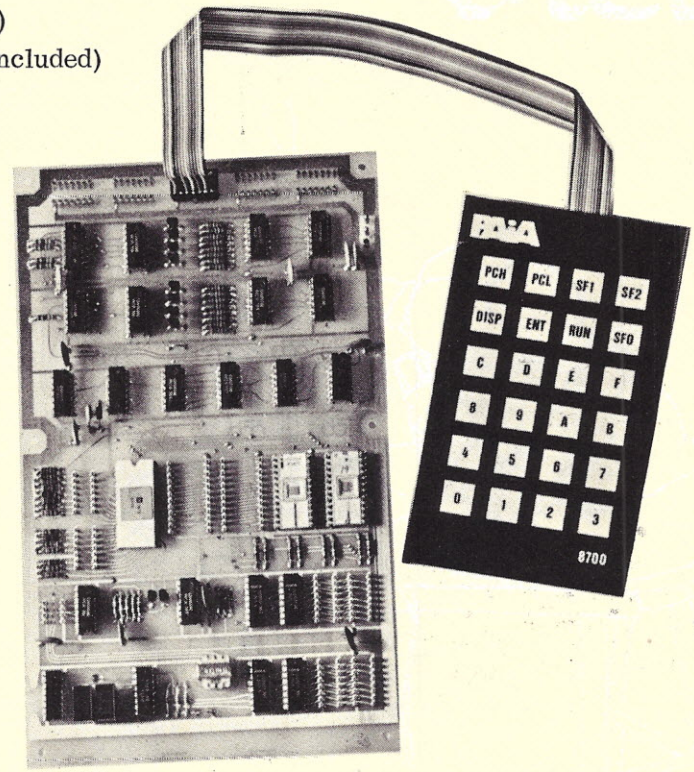
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KILOBAUD KLASSROOM NO. 4



PC boards and power supplies

George Young
Sierra High School
Tollhouse, CA 93667

During the last session we investigated number systems, the seven segment decoder, an LED register, and our first linear circuit chip, the 555 timer.

Now we're ready to tackle PC boards, power supplies and voltage regulation. The PC board technique used will be the least expensive, fastest method I've found, and is suitable for one-board-at-a-time construction. We're going to design a PC board for the clock circuit in the student console (which will complete construction of the console). Power supplies could very easily be the subject of an entire article. The same thing applies to the subject of regulation.

PC Boards

The term *printed circuit board* is a misnomer. Printing is an additive process. If I read the current literature correctly, we will soon have PC boards made by actually printing the circuit patterns on an insulating board. But right now. we are going to be talking about *etched* circuit boards, and etching is a subtractive process. The name PC board has been with us for a long time, and we are not going to fight it. We will also call our boards PC boards, even though we will use the etching process. Our end result should look like the PC board in Photo 1.

Certain materials and terms are common to every method used to make PC boards. A thin sheet of copper is bonded to some kind of insulating board with an adhesive. The copper clad board that I used for my first circuit board was made by cementing a thin sheet of copper foil to a piece of plastic laminate. You could also make copper clad board this way, but today it is just as economical to buy the finished product, and it's quite a bit better.

The second common factor in PC board construction is called *resist.* Resist is any material that will resist the action of the etching solution. Many things can be used for the resist. What you need is something cheap,

effective, and easy to apply.

The third common factor is the etch, and again, there are different materials that can be used. Ferric chloride solution is the one we will use. A container, which I call a boat, must be used for the actual etching process. The boat should be made of glass or plastic. Metal containers must not be used.

Finally, a small diameter drill is needed to drill holes in the etched circuit board to allow parts and chips to be inserted (stuffed) and then soldered.

The five things just listed are necessary for any method of PC board construction. There are a lot more things that make the job faster, easier or better, but the five just described are essential to any method used.

I am going to teach you how to make a PC board by describing the steps here, which is not going to be easy or particularly efficient. It will take longer to write out and to read all the steps than it will take to do them. Do each step in sequence.

Laying Out The PC Pattern

Use a sheet of graph paper ruled 10 lines to the inch. This is the easy way to do the layout. If you don't have this type of graph paper, read on; we can still get the job done.

On the upper half of the sheet make a copy of the circuit diagram that you are going to lay out. The graph paper helps by giving you a rectangular grid to make neater circuit diagrams. Having the diagram immediately in front of you helps prevent errors in layout. Every time you copy a circuit diagram, a little bit of the electronics gets stored in your brain. The more circuit diagrams you draw, the faster you learn the electronics. If you are not using graph paper, the circuit diagram still goes on the upper half of the sheet. The circuit that we are going to lay out is given in Fig. 1.

Place the 555 chip on the lower half of the paper, and locate the positions of all eight pins on the graph paper. The grid line intersections make this step reasonably simple. If you do not have the graph paper, then we must use an alternate approach.

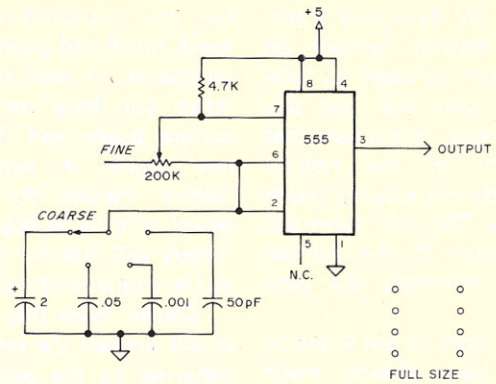


Fig. 1. Console clock circuit and 555 timer pin layout.

I suggested a technique in an earlier class session which I will repeat here. Place a sheet of scratch paper over the hole pattern on the Superstrip. Lightly shade the paper with a pencil until you can see the pattern. Remove the Superstrip and place the shaded paper on a newspaper or old magazine. Circle the hole positions that correspond to the eight pins of the 555 with a pencil. Make a plastic template by punching through paper, plastic, and magazine using the scribe we made in class session 1 (May issue). Using this template, punch 8 holes in the sheet of paper to locate the pin positions for the 555 chip. At this point, your layout should look like Fig. 1.

Identify the positions of pin 1 on the 8-hole pattern. This step is so important that we have deliberately positioned it in the most unlikely position of all for layout. We have even indicated the position of pin 1 in Fig. 2a with a little flag. We emphasize here that the pin positions get reversed as you read the chip from the bottom, and Fig. 2 is a look at the bottom.

Now, using the circuit diagram above your layout area as a guide, put in a pad for the wire that will connect pin 1 to -. (See Fig. 2b.)

Move on to pin 2. Pin 2 connects to pin 6, so we put in a line from pin 2 to pin 6 (see Fig. 2c).

Pin 3 is the output and will have a wire going to the clock output bolt on the console front panel. So, in goes another pad for this wire (see Fig. 2d).

Pin 4. Oh, oh! We cannot connect directly from pin 4 to pin 8 and + since the trace from pin 2 to pin 6 blocks our path. We could go out and around pins 3, 2 and 1 and over to pin 8, or we could go out and around the other side, but instead we will use the blockade to introduce the *jumper*. Put in a pad next to pin 4 and another pad next to pin 8. We will use a wire placed on the chip side (called the component side; the side of the board that we are working on is called the foil or trace side) to get pins 4 and 8 connected. This wire is called a jumper. We have indicated this jumper wire as a dotted line in Fig. 2e.

Pin 5. This is the easy one. No connection.

Pin 6. Pin 6 goes to pin 2. We got that already. Pin 6 also goes to the speed control (clock fine adjust) and to the timing capacitor switch (clock coarse adjust). So two pads are needed for these two wires (see Fig. 2f).

Pin 7. Pin 7 has a 4700 Ohm resistor (4.7k) and a wire out to the speed control pot. The other end of the 4.7k resistor must end up on +. Lay the 4.7k resistor that you plan to use on the pattern layout. Put in two pads, one for each end of the resistor. We have oriented this resistor vertically as shown in

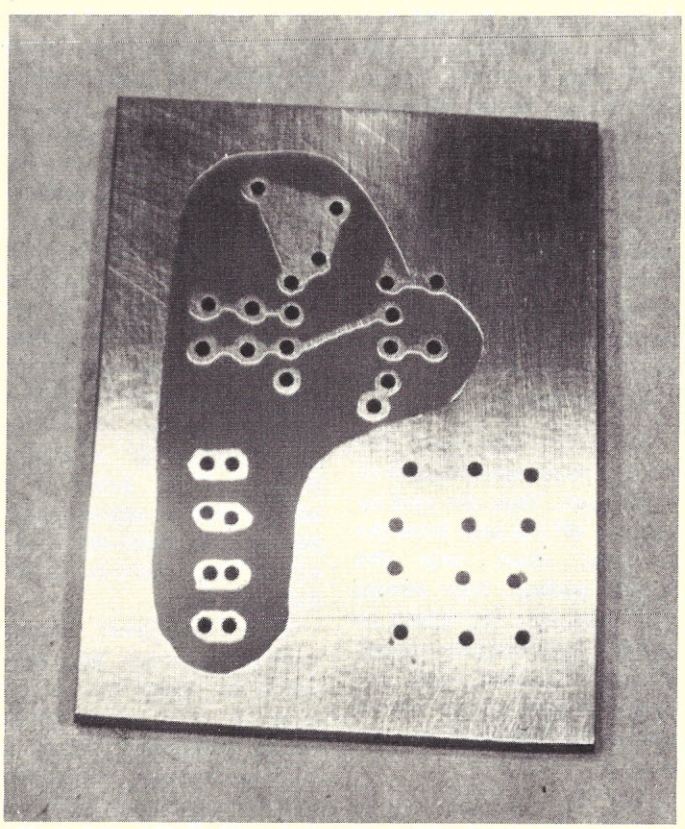


Photo 1. Etched and drilled console clock PC board.

Fig. 2g. We have also drawn in the resistor symbol on the pattern to show its location. If you also put this in with resist, make sure that the ends of the resistor symbol do not actually touch the pads. This will short out the resistor if the symbol actually connects the pads together.

Pin 8 goes to pin 4 and to +. We have already made provisions for connecting pin 4 to pin 8. Another pad is added to provide for the connection of pin 8 to +. The 4.7k resistor also goes to + on one end, so all of these points get tied together (see Fig. 2h).

This takes care of all the pins on the chip and all the pins on the circuit diagram. The next step is to double check everything and make certain that we did not miss anything. Here we are actually wiring up the circuit, so any errors now can be easily eliminated with a pencil eraser; errors discovered later are much more difficult to correct.

Now we are going to mount the timing capacitors on the PC board. We will add extra holes in the ground foil portion of the timing capacitor section so that capacitors of different lengths can be utilized without having to measure them ahead of time.

The last step is optional. We are going to run the ground foil all the way around the outside of the circuit pattern. This places the periphery of the circuit board at ground potential and simplifies the mounting of any circuit board. It also means that we have to etch away less copper, so the circuit will etch faster and we will get the board completed sooner. The final layout is shown in Fig. 2i.

Copper Clad Layout

Cut a piece of single-sided copper clad board to the size delineated by your layout. After you have cut it, polish it bright and shiny. Steel wool is the fastest method, but you can scrub it with a tooth brush and cleanser, fine sandpaper, or even an eraser. After you have the copper surface bright and shiny, *do not touch it with your fingers*. Handle the cleaned board only by its edges. Your fingers will transfer body oil to the copper surface.

Copper loves this oil, and it will prevent the resist from adhering to the copper surface.

Hold the cleaned board and your layout up against a bright light with the board behind the paper. Position the copper clad board behind your layout. Return the pair to the work surface without allowing them to move. You can tape the two in position if you want to.

With the scribe (or any sharp-pointed tool) transfer the hole and pad locations to the copper surface. Easy does it. All we want is a very light pin prick in the surface, just enough to allow us to see the pad location. We do not want a center-punch type of indentation. Press the probe firmly against the copper surface and rotate it slightly. This will be just about right. Double check each hole location to make sure that you did not miss any pads. This is especially true for the IC pin locations.

Hold the copper clad up to the light so that the light reflects off the surface. With a pencil draw a small circle around each pin prick. Return the copper clad to the work surface. Using your layout as a guide, re-establish the circuit board pattern. If you make a mistake, erase it. Draw in the circuit board pattern in pencil. Double check before you start with the resist. Get everything right at this point.

Resists

What to use for the resist? A resist pen can be used, but I find it difficult to get the detail that I require. Speedball Extra Dense Drawing Fluid has been used successfully and can be applied with an ordinary pen point. Ordinary India inks have been tried, but most of them have come off in the etchant, and therefore are not recommended. Grumbacher Ink Concentrate has been used with success.

Some of the new dry transfer materials are made in resist form. They are used by rubbing off the pads from the transfer sheet onto the copper surface, then adding the traces and burnishing to seal the resist onto the copper surface. Masking tape, or plastic electrical tape can be used with varying degrees of success.

My favorite resist is a material called bitumol (pronounced bitch-mole). This is a petroleum product that will dissolve in water. It is a light brown color in solution and dries to a black, tarry substance in a few minutes. It makes an excellent and very inexpensive resist.

Bitumol in a water solution is the same stuff that county and state road maintenance crews spray on pavement prior to patching holes in it. A couple of grams of this stuff dissolved in water with 1 drop of household dishwashing liquid detergent will make enough resist to last you for years. It will probably be as easy for you to bum a small quantity from the state highway department as it will be to find a supplier who will sell you some. It is put up in 55 gallon drums, and I'm afraid that would be a bit more than you could use in a couple of lifetimes. Besides, my Scot's blood dictates that you should scrounge whenever possible. The bitumol is applied with an old-fashioned pen point for detail areas, and with a small paint brush for the larger areas.

Use whatever resist material you can get your hands on. Make the pads as large as you can without having them short circuit to an adjacent pad. Remember that we are going to drill each pad, and if the pad is too small there will be no copper

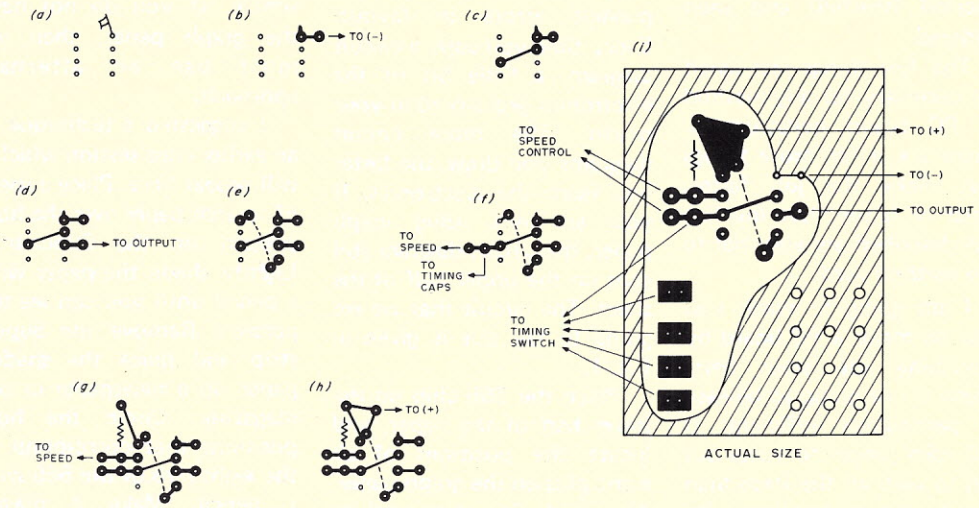


Fig. 2. PC board layout (bottom view).

left to solder to. If adjacent pads short, allow the resist to dry, then scrape a line between the two pads with any sharp pointed instrument. If you make an error in applying the resist, allow it to dry. Then scrape off the error, and redo that portion of the circuit traces. Also, the more copper you can leave on the board, the less likely you are to have a trace or pad lift off the insulating substrate during the soldering operation.

Etching

Pour the etchant from its storage container into the boat. If you don't have a plastic or glass container that is suitable, then try this: Take a half-gallon milk carton, slice it lengthwise, retaining the sealed portion, and use it for the boat. It has the advantage of low cost and easy disposal, and will etch several circuit boards before it must be replaced.

Keep ferric chloride etchant off your clothes and hands. It will stain clothes permanently. It will eventually wear off your hands. If you inadvertently come in contact with the etchant, flush it off immediately with water. If you etch in the kitchen sink, your wife will probably allow you to sleep on the sofa. Ferric chloride will stain the sink, and it will require a great deal of energy on your part to clean it. Etch in an old sink or out in the back yard to keep peace in the household, and be sure to keep it off your clothes.

Hold the copper clad face down and almost touching the surface of the etchant. Then drop it in so that surface tension allows the copper clad board to float. Floating face down on the etchant allows the etching to take place without agitation. If the board sinks, then it will have to be retrieved from the bottom, turned face up, and agitated during the etching process. Retrieve it with a piece of scrap hookup wire, and turn it over with this wire, not your fingers. With fresh etch, about 20 minutes at room temperature will do it. Use the scap wire for inspection of the board.

Heat can be used to speed the etching process. A heat lamp, or even an ordinary reflector flood lamp can be used. Place the lamp about 18 inches from the boat. If the milk carton boat is used, be careful not to melt the wax that makes this boat waterproof. Direct sunlight outside will also speed up the etching process. The ferric chloride etching process appears to be a photosensitive reaction.

When the etching process is complete, allow the board to sink in the boat. Pour the etchant back into its container, and flush off the boat and board (still in the boat) with large amounts of water. Continue until no traces of orange or green liquid remain. Dry the board.

Finishing the Etched Board

Remove the resist. Bitumol comes off with any petroleum solvent. Dampen a rag and wipe off the resist. Other resists can be removed with steel wool. Polish the board bright and shiny again.

Carefully examine the board. If any traces are shorted, cut them apart with a sharp pen knife. If extensive surgery is indicated, a hacksaw blade removed from its frame and handheld can be used. Small blobs, or speckles can be removed with the pen knife or a small file.

Drill the board. A #60 drill is usually specified. Anything reasonably close will work. A drill press is nice, but an electric drill hand-held drill can be used. (Carbide PC drill bits are available for $.50 each from: Cut-Rate Electronics, 1915 Tuolume St. Fresno CA 93721. Better buy two; they break easily.)

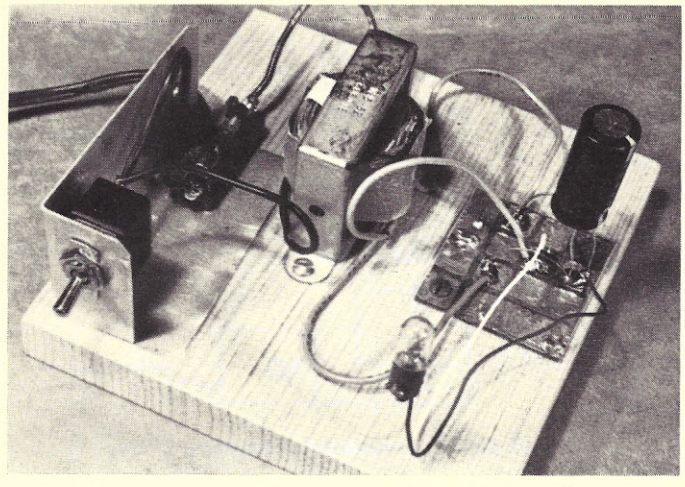


Photo 2. "Breadboard" unregulated supply.

Polish the board again with steel wool and tin the large areas with solder. Do not tin the pads.

Stuff the board. The jumper(s) always go in first. Then the resistors, then the chip(s), and finally the larger components. The purpose of this sequence is to have the board lie as flat as possible during assembly. Therefore the larger, more bulky components go in last.

Function test the completed board. Plug the completed board into the Superstrip using the wires attached to the board. It is much easier to troubleshoot out front than it is behind the panel. When you are satisfied that the circuit board is operational, it can be installed behind the panel. This will complete the console front panel.

Substitutions

We promised in an earlier class session to show you how to get around the requirement of the 4-pole single-throw switch. This is the coarse frequency control on the console panel, and switches in different values of capacitance to change the basic 555 clock frequency range. If you don't have this switch, here is a way around it.

Mount a transistor socket in the 3/8 hole for the switch. Connect only two wires to the circuit board, one to pin 6 and one to ground. Connect these two wires to two of the pins on the transistor socket. Now different values of capacitance can be plugged into the transistor socket to change the basic clock frequency range.

This is a nice little variable speed clock circuit that will run up to 100 kHz or a little beyond. It has sufficient drive to drive almost any IC that you might wish to clock. It has good frequency stability which can be slightly improved by bypassing pin 5 on the 555 to ground through a .01 disk capacitor.

Power Supplies

As mentioned in the preview, an entire article could easily be devoted to power supplies, and a second article could be devoted to voltage regulation. For now, we will only cover the pertinent details of power supplies leaving a detailed inquiry to another time.

Experiment #17
The Unregulated Power Supply

Purpose: a. To build a power supply for the console. b. To study the fundamentals of any power supply.

Equipment: 1) Line cord, fuse holder and fuse, ½ Amp, SPST toggle switch. 2) Power transformer; 120 V ac primary, 12.6 V ac @ 1 A secondary, centertapped. 3) Filter capacitor, 1000 uF (or more) at 15 V dc (or more). 4) A terminal strip or PC pad board for mounting components. 5) Two silicon

diodes, 1 Amp (or more) at 25 PIV (or more).

A dc voltmeter is desirable for testing the completed supply. However, if a voltmeter is not available, a pilot lamp can be substituted.

Symbols: Refer to Fig. 3 for the new symbols introduced for the power supply.

Circuit: Refer to Fig. 4 for the circuit diagram.

Procedure: Anchor the various components temporarily on a block of wood, about 15 cm x 15 cm. Haywire the components together as shown in Photo 2. Caution: 120 V ac is exposed and must be considered lethal. Do not work on the circuit while the line cord is plugged in. Always disconnect the line cord while working on any circuit. Do not touch anything while the line cord is plugged into the 120 V ac outlet.

After all connections have been completed, we will conduct a smoke test. This is exactly what it sounds like. We plug the power supply in, turn on the switch and look for smoke. If we get smoke, that's bad. Immediately pull the plug and start looking for the problem. If we don't get smoke, that's good, but it is no guarantee that things are working.

Check the output voltage with a dc voltmeter. Connect the + lead on the voltmeter to the + lead on the filter capacitor. Connect the - lead on the voltmeter directly to the - lead on the filter capacitor. Set the range switch on the voltmeter to 15 V dc (or more) and the function switch on the voltmeter to dc+. If the voltmeter probe has a switch on it, it should be placed in the dc position. The dc output voltage of our power supply should read about 9-10 V dc. If no voltmeter is available, a #44 or a #47 pilot lamp can be substituted.

First connect the pilot lamp across the 6.3 V ac winding of the power transformer. This will be across center tap and *one* of the transformer wires going to a diode. Wires may be soldered directly to the bulb for this step, or the bulb can be mounted in a socket, and wires attached to the socket. The lamp will glow with a certain brilliance. Then connect the bulb to the power supply output (directly across + and - on the filter capacitor). The lamp should glow more brightly than it did connected across 6.3 V ac. Use care in this step and stay clear of the 120 V ac circuitry.

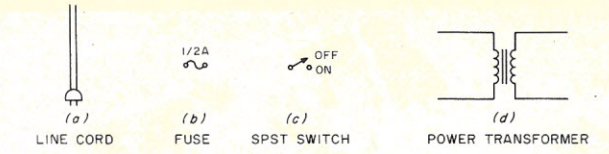


Fig. 3. New symbols introduced.

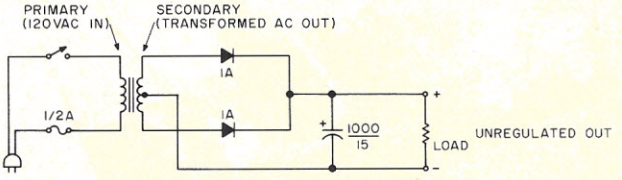


Fig. 4. Console unregulated power supply circuit.

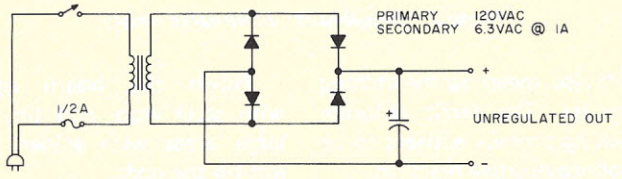


Fig. 5. Full wave bridge circuit.

Theory: Alternating current (and voltage) or ac comes in on the line cord. The SPST switch provides a means of *breaking* or *making* the current path, allowing us to turn on or turn off the power to the transformer. The fuse provides a safety valve, and will burn out (open or blow) if something is drastically wrong, or something fails in a circuit. Always install a fuse in a circuit that feeds power to any transformer. The fuse is relatively inexpensive and much cheaper than the transformer or your house.

Alternating current enters the *primary* of a transformer where it is *transformed* either up or down in voltage, and either up or down in current. If the voltage goes down, the available current goes up. If the voltage is transformed up, the available current goes down.

This transformation of voltage and current in a transformer is accomplished by magnetic forces. A changing magnetic field is necessary to accomplish this. Direct current has a steady magnetic field, and if we connect dc to a transformer, we will get smoke. *Never connect ordinary dc to a transformer winding.*

The transformed ac, which in our power supply is transformed from 120 V ac to about 12 V ac out (a 10:1 reduction), comes out to the *secondary* and is then fed to a pair of diodes. Centertapping the secondary winding of the transformer produces two identical ac waveforms, 180 degrees out of phase with each other. As one ac waveform goes in a positive direction, the other waveform goes in the opposite direction or in a negative direction.

As one ac waveform goes in a postive direction, one of the diodes is forward biased, and conducts. Current flows from ground through the load (the circuit that is taking power from the power supply) through the diode that is conducting, through one half of the power transformer secondary and back to ground.

During the other ac cycle the other diode is switched into the circuit, conducts, and current flows through the load, through this diode, and through the other half of the transformer secondary back to ground. Since current is flowing in only one direction through the load, the diodes are changing the ac to dc. The process of changing ac to dc is called *rectification*, and the diodes are often called rectifiers. Since we have a circuit that is producing two pulses out for each 60 cycle pulse in, we have a frequency doubler circuit.

The filter capacitor charges up each time a diode delivers a current pulse to it. As the ac waveform falls, the filter capacitor feeds stored electrons back into the circuit, thus helping to smooth out the 120 cycle pulses. Any remaining 120 cycle pulses are called ripple.

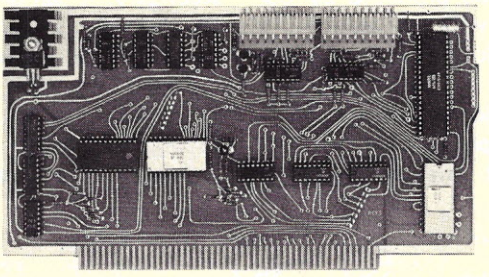
Peak Inverse Voltage

Let us assume that you have a 120 V ac soldering iron (as opposed to an iron that is operated from a step down transformer) and that your soldering iron is plugged into 120 volts dc. The iron will reach a certain temperature. Now suppose you plug your soldering iron into 120 volts ac. The soldering iron will again reach the same temperature.

How is this possible? Part of the time the ac is zero, and at all times it is either rising or falling; it is never stationary. The 120 V ac value is called the Root Mean Square (RMS) value of the ac. It is the ac value that will provide the same heating value of a

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This recorder requires one parallel port for motor control, and one serial port for data and clock. (Cannot be used with UART's or UART boards such as the 3P+S). Used with USART's, ACIA's or other 1/1 clocking I/O devices under software control only. No manual controls. Software for 8080 and 6800 available. Power supply is built in, 110 V, 60 Hz. 220 V, 50 Hz for export.

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comparable dc voltage. Since part of the time the ac is zero, the 120 V ac RMS voltage must go higher than 120 volts to provide the same heating capability as 120 volts dc. In fact, it must go 1.41 times the RMS value. Since the ac also swings an equal distance in the negative direction as well, the peak-to-peak (P-P) value, from the top of the positive-going waveform to the bottom of the negative-going waveform, is 2.82 times the RMS value.

The filter capacitor in a power supply circuit will therefore charge up to this peak value, or about 1.5 times the RMS value. The diode that is conducting is subjected to the ac voltage plus the dc voltage from the capacitor. So the peak inverse voltage or peak reverse voltage (PIV and PRV, respectively) rating of the rectifier diodes must be about 3 times the RMS voltage of the transformer. At 3xRMS there is no safety margin for diode. In a TV set that operates directly form the ac line, the rectifier diode has a PIV of 400. This is 3xRMS plus a safety factor.

The RMS value of our circuit is 6.3. Multiplying by 3 gives almost 19 volts. Adding a little for the safety margin, you can see why we specify 25 volt PIV diodes. Our transformer will only deliver 1 Amp of current, so we can easily get by with 1 Amp diodes. You may use any diodes with more PIV rating or more current rating.

Capacitance

Capacitors store electrons. The more microfarads of capacitance, the more electrons they will store. Therefore the larger the capacitor the better the filtering of the power supply.

In our power supply circuit, 1000 uF makes a reasonable filter. 2000 uF would make a better filter capacitor, and 5000 uF would be better still.

Capacitors have another rating that we need to discuss. Capacitors have a dc working voltage rating. This is the dc voltage at which they are guaranteed to work without breaking down and shorting. Ha! Sometimes they short anyway.

The dc produced by our circuit will be around 10 volts. We possibly could get by with a 10 volt capacitor. We would be far better off to use a capacitor rated at 12 V dc, and one at 15 V dc working would give us the necessary safety margin.

As you learn more electronics, you will discover that parts used in a circuit can be changed to different values and the circuit will still work satisfactorily. In fact, the whole philosophy of Kilobaud Klassroom is to use what you have on hand. Try it and see if it works. As your knowledge of electronics expands, your treatment of published circuits will change. The idea is to make them work with what you have, not necessarily what the author of the article put into his circuit.

Transformers

If you have a transformer with a 1 Amp 6.3 volt secondary, it can be used for the console power supply. Use the full wave bridge circuit of Fig. 5. If your 6.3 volt transformer has a current rating of more than 1 Ampere, you may be disappointed in the results. A smaller transformer has a little extra voltage (a few more secondary turns) out because it is not as efficient as a heavier current transformer. Our power supply produces about 10 volts for this very reason, and a 1 Amp 6.3 volt transformer will produce about 9 volts with the bridge circuit for the same reason. Voltage regulators need a little extra margin of voltage to work on, so they must have more in than you want out to function properly. Since we are haywiring the unregulated supply, try what you have on hand before you dash out and buy what I specify to be used. You can always buy the components later if you are dissatisfied with the results.

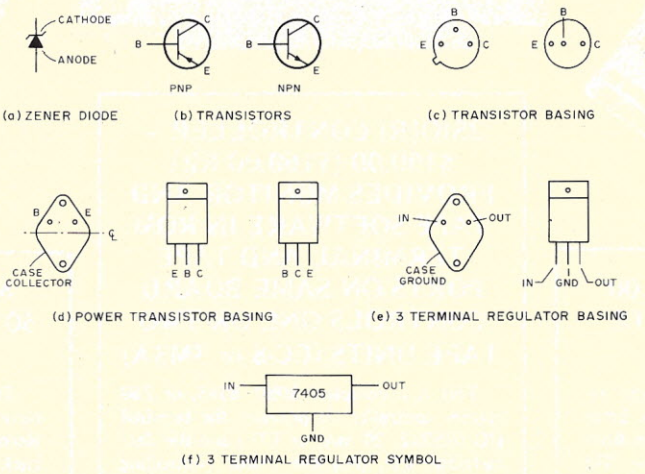


Fig. 6. New symbols added.

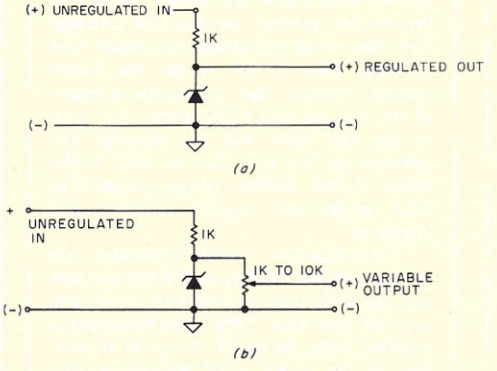


Fig. 7. Zener diode regulation.

Safety

Stay clear of the ac line circuitry when this power supply is plugged in. Never work on any circuit that is plugged in. When measuring voltages on any HOT circuit, use caution. Think safety. Act safely. I'll give you a simple safety rule: follow it. The life you save may be your own.

Safety Rule: If you must work on a live circuit, place your left hand in your rear pocket, and use only one hand. You can get a nasty shock, but you probably won't get killed.

This safety rule normally provides sufficient protection while working on 120 volt circuits. We are attempting to prevent current from flowing through the heart. With only one hand capable of contacting electrical power, the path through the heart is eliminated. Shoes and their insulation are usually sufficient to block that path. Of course, if you are standing in a puddle of water outside, this safety rule won't help much. There is no such thing as a *foolproof* safety rule, but this very simple one will help.

Do not connect the output of the power supply directly to the console. 10 volts is definitely not a TTL level. If you connect this output directly to the console, you will ruin all your hard work behind the panel and will have to make a lot of replacements. We must regulate the 10 volts to the TTL level with appropriate circuitry.

Voltage Regulation

The output voltage of our power supply is about 10 volts. As the load (amount of current taken from the power supply) increases this voltage sags lower and lower. What

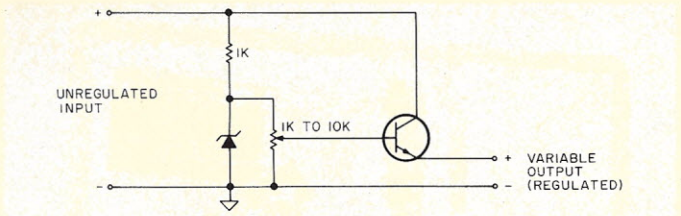


Fig. 8. Variable output regulator.

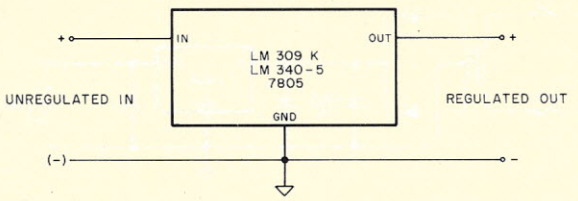


Fig. 9. Three-terminal regulator circuit.

we need is some circuitry that will hold the output voltage at 5 volts over a wide range of current drain. Such circuitry is called voltage regulator circuitry.

We will start with a simple regulator, progressing on to more complex circuits. For a power source we will use the unregulated power supply just completed. After we finish the next series of experiments, the power supply will be built into the console. Before you go one step farther, disconnect the front panel from the Superstrip. Pull the rail feeder wires coming from the bolts in the front panel out of the Superstrip rails. Push them to one side. The two pairs of jumpers in the center of the Superstrip can remain, but all that work behind the front panel *must* be disconnected from the Superstrip.

Connect two fairly long wires from the + and - on the filter capacitor, and plug these into the Superstrip power distribution rails. We will use the unregulated power supply and the Superstrip in this configuration for the next series of experiments. If a voltmeter is not available, proceed to the portion of experiment #18 dealing with the three-terminal regulators and do only that section. Later when you do have access to a voltmeter, come back to experiment #18.

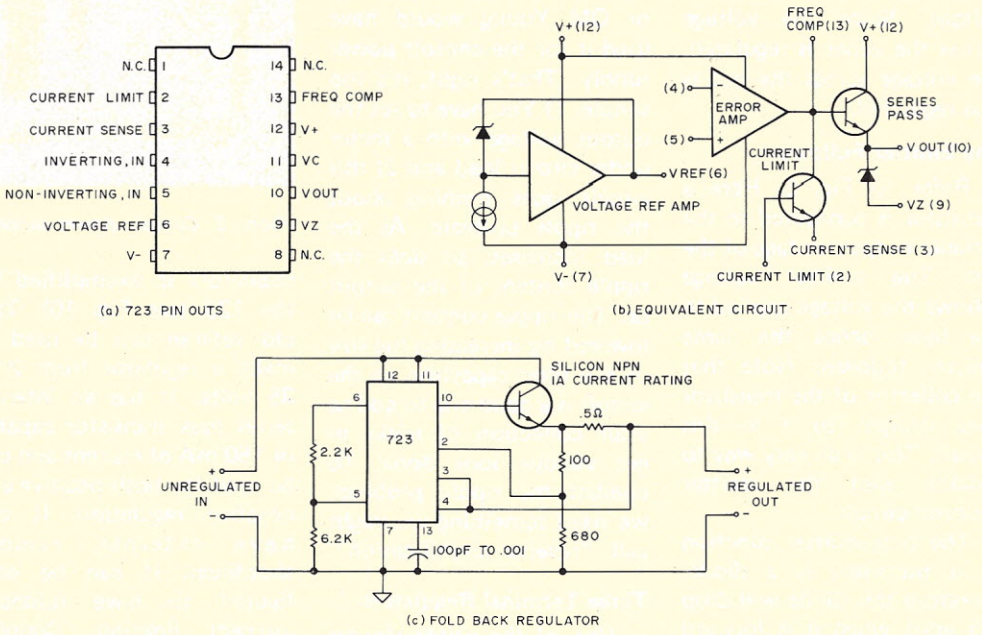


Fig. 10. 723 regulator circuit.

Experiment #18
Voltage Regulation

Purpose: a. To investigate the zener diode voltage regulator. b. To examine the emitter follower. c. To study the three terminal regulator. d. To look at the 723 regulator chip.

Equipment: 1) A zener diode of less than 9 volts, or a silicon transistor. 2) An NPN power transistor of 1 Amp (or more) capability. 3) A potentiometer (pot), 1k to 10k. 4) A 5 volt, three terminal regulator, LM 309K, LM 340-5, 7805, etc. 5) A 723 linear IC in a DIP package.

New Symbols: Refer to Fig. 6 for the new symbols added.

Circuits: Fig. 7 is the circuit for the zener diode portion of the experiment. Fig. 8 is the circuit for the emitter follower. Fig. 9 should be used for the three terminal regulator. Fig. 10 shows the circuit for the 723 regulator.

Procedure: Read the theory section first on each type of regulator circuit. When you feel that you understand what the circuit is supposed to do, connect it to the console breadboard and verify its operation. A voltmeter is mandatory for these experiments. If a voltmeter is not available and you can't find one of our resource persons mentioned earlier, you will be able to do only part 4, the three-terminal regulator circuit.

Theory: A zener diode is a special kind of diode. It is made to operate with reverse bias applied to it; + to the cathode, and - to the anode. A current limiting resistor must be used in series with the zener diode. As the voltage across the zener increases, a voltage level will be reached at which the zener will break down and conduct. Once this zener voltage is reached, the voltage across the zener diode remains constant or regulated. A zener diode will only supply enough current for one or two ICs. Thus the simple zener diode regulator must be helped out if it is to provide the regulation for a Superstrip full of chips.

Zener diodes average around 50¢ each. The base-emitter junction of silicon transistors is a zener diode. There may be some that don't zener, but I haven't found them yet. This zener voltage is between 4 and 10 volts, with the great majority lying in the vicinity of 9 volts. So a base-emitter junction makes a 10¢ zener diode. Try one and see. If the zener voltage of the particular transistor that you try happens to zener above 10 volts, you will not be able to see the zener effect without finding a power supply that will go higher in voltage. If you read 0.6 volts when you have the transistor diode or the zener diode in the test circuit, you have the junction forward biased (same as a short). Reverse the connections to anode and cathode to reverse bias the diode and cause the zener action to take place.

Refer to Fig. 7b. If a pot is connected across the zener diode, the wiper of the pot can be moved from ground

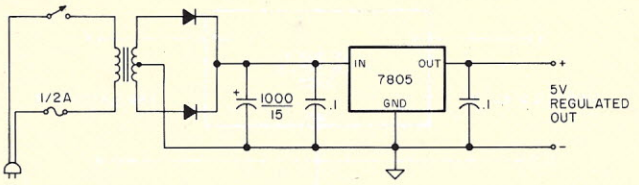


Fig. 11. Console power supply and regulator.

(zero volts) up to the zener voltage. Since the voltage across the zener is regulated, the voltage across the pot is also regulated.

The Emitter Follower

Refer to Fig. 8. Here a transistor is connected to the variable output voltage of the pot. The emitter voltage follows the voltage applied to the base, hence the name emitter follower. Note that the collector of the transistor goes straight to + in this circuit. This is an easy way to quickly spot the emitter follower circuit.

The base-emitter junction of a transistor is a diode; therefore this diode will drop 0.6 volts when it is forward biased. The output of an emitter follower can never equal the input on the base; it will always be one diode drop below the base voltage. The circuit will run our console however, because the emitter follower is a current amplifier. Connected as shown in Fig. 8, we have a variable output voltage power supply which can be very handy at times.

We just said that the emitter follower circuit cannot amplify voltage. It is, however, a current amplifier. This can be demonstrated with a couple of numbers. Suppose the control current is 10. If the dc gain (called the *Beta* of the transistor) is 100, then the output current capability of the combination is 10 x 100 or 1000. While I did not bother with the units, milliamps can be added to the numbers (10 mA x 100 = 1000 mA or 1 Amp). Thus a zener control current of only 10 mA can control 1 Amp at the output of the emitter follower.

Now, this circuit must have something wrong with it or OM Young would have used it for the console power supply. That's right; it's too simple. 1) You have to set the output voltage with a meter under circuit load and 2) this circuit does nothing about the ripple problem. As the load increases, so does the ripple content of the output dc. The ripple content can be lowered by increasing the size of the filter capacitor, so the circuit is a good one to add to your collection of tricks to get various jobs done. To combat the ripple problem, we need something we might call "reverse amplification".

Three-Terminal Regulators

One of the newer devices that has been developed in this area is the three-terminal voltage regulator. The terminals are input, ground and output. You buy the regulator for the voltage that you want out, connect slightly higher unregulated voltage to the input terminal, ground the case, and take the output voltage and use it.

There is a whole bunch of goodies inside the package; several zeners, amplifying transistors, a series pass transistor, and several resistors. All this circuitry regulates the output and takes care of what I called reverse amplification. Most of these devices will handle an Amp of current, so for our console power supply regulator this is the simple way to go. Newer four-terminal regulators are adjustable, but they are more expensive. For our purposes, the 5 volt, three-terminal regulator is entirely satisfactory.

Regulator Chips

Another class of voltage regulators is exemplified by the 723 (see Fig. 10). This old veteran can be used to make a regulator from 2 to 35 volts. It has an internal series pass transistor capable of 150 mA of current and can be used for both positive and negative regulation. It can have external, remote shutdown. It can be configured to have foldback current limiting. Coupled with an external series pass transistor, or transistors, any amount of current can be regulated.

Foldback current limiting means that if we inadvertently short + and - together, the regulator shuts down. Nothing happens. Everything returns to normal as soon as the short is removed. With high school students, it is the only way that my lab supplies have survived. You should investigate all these circuits in the interest of expanding your knowledge of electronics.

Finishing The Console

When the power supply and voltage regulator circuits are all functional, the entire supply can be built into the console (see Photo 3). The space immediately below the Superstrip should be used for this purpose. If the transformer you have selected is too large for this space, it will have to be mounted towards the back where there is more space available.

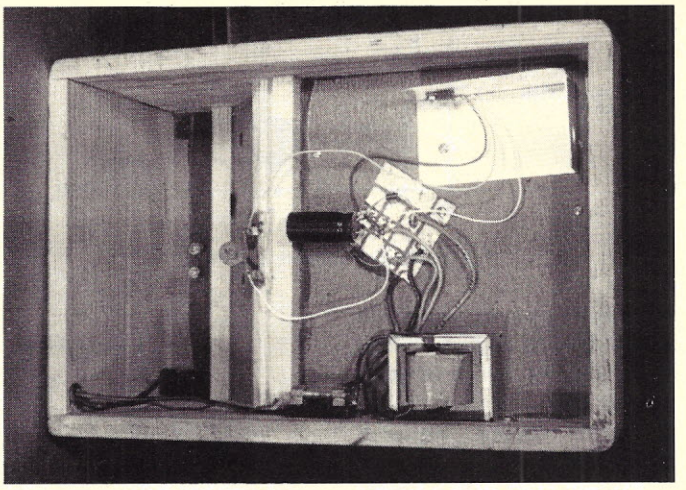


Photo 3. Console power supply and regulator installed under console.

A piece of copper clad board, cut into pads with a hacksaw blade makes a handy solder terminal on which to mount parts. A piece of aluminum or copper bolted to the 5 volt, three-terminal regulator serves as a heat sink. Use the largest heat sink that will fit into the available area. My students are using part of an old chassis from an earlier era for a heat sink as seen in the photograph.

The series diode used to drop the 6.0 volts of the battery to TTL level can now be eliminated. Since the power supply will now be permanently attached to the Superstrip, reverse polarity protection is no longer needed. The console power disconnect switch can now be wired to turn the power supply/voltage regulator on and off. The final suggested version of the console power supply is shown in Fig. 11.

Preview

In class session 5 we will have a continuity tester that I call the Squawker. We'll take a look at the rest of the NAND gate family, the 3-input, 4-input and 8-input gates. This will be followed by the NOR gate. Then we'll look at all four logic functions: AND, NAND, OR and NOR.

We'll need the following ICs: another 555, a 7410, 7420, 7430, 7402. Sierra Electronics package price for this group is $2. ■



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Seals Electronics

. . . a visit with the memory people

J. Tom Badgett
1917 Washington St.
Bluefield WV 24701

"What's behind your demand for perfection and quick delivery; why do you work so hard?" I asked Bruce and Sandra Seals over lunch in Knoxville, Tennessee. We'd spent the morning discussing the founding and operation of Seals Electronics, and I reflected on that during the brief, almost embarrassed silence which followed my question. An understanding spark passed between them. Bruce smiled. It was Sandra who answered:

"I guess it's really because Bruce grew up in Lonsdale — you know Lonsdale?"

I did. A low-income area of Knoxville where youngsters and families survive on the hope that things will get better or they'll find a way out. Things are better now, but in Bruce's day it seemed few broke the chain and realized their dreams of a better life.

"I never want to be that low again," Bruce responded softly to my quizzical look.

That isn't likely. It's hard to say exactly how the series of events meshed for Bruce and Sandra to put them on top of a rapidly growing electronics firm with an excellent product and an even better reputation. But you can bet their success came in part from that childhood motto Bruce heard so often in Lonsdale: "No guts, no glory." It was probably that motto that got him into the

Army at an early age, and made him transfer to the Air Force to pursue an electronics career. It was this decisiveness that got Sandra and Bruce together. They met when Bruce was in Knoxville on a two-week leave. They didn't see each other again for nine months, but their minds were made up. They married the next time Bruce came home.

Bruce was working for an electric fence company when he got his first patent. He suggested a battery operated charger for the fences. The boss told him if it could be done an electronic charger would have replaced the old electromechanical models years ago. Just the kind of challenge Bruce needed. Within a few minutes he had a design, and when he built it up, it worked.

There was the fence charger service company; a good paying job as a design engineer for Oak Ridge Technical Enterprises Company (ORTEC), a nuclear instrumentation company; a brief stint wholesaling Teletype sets to Western Union; and a Tennessee-wide Mits-Altair franchise, the Bytetronics store in Knoxville. Some of these jobs ran concurrently.

Sandra wasn't sitting around. She worked for some time with the state rehabilitation and welfare office, but when family businesses needed her, she was typist, bookkeeper, order-filler, mail-room clerk. Now with Seals Electronics she sorts parts (so do Bruce and the two Seals youngsters), takes care of orders, handles bookkeeping and the files. In the beginning she even built some of the Seals boards for sale to customers who wanted theirs assembled.

Seals Electronics grew out of all of these experiences, but it probably was the Altair dealership which offered the final initiative. Bruce built up an early Altair kit in February of 1975. In July he was in Albuquerque to talk with Ed Roberts about an eastern service company for the Mits product. He came back to Tennessee with a state-wide franchise instead. Bytetronics was the first Altair store in the East and they'd been promised three day delivery from Albuquerque. But Mits was having growing pains. Three days became three weeks, then six. Bruce ended up with $14,000 in customer deposits for products he couldn't get, and "a very uncomfortable feeling."

Since most of the delays were on memory boards, it seemed natural to roll their own. Drawing on his own expertise and that of nine other engineers in the nuclear industry, Bruce came up with the now-familiar Seals design.

Those $14,000 in deposits were haunting him even more than the old Lonsdale motto, so he vowed he wouldn't advertise anything he couldn't ship in ten days or less.

"I guess our marketing philosophy is just that we're treating the dealers and the public like we wanted to be treated when we were a dealer and a hobbyist," he says.

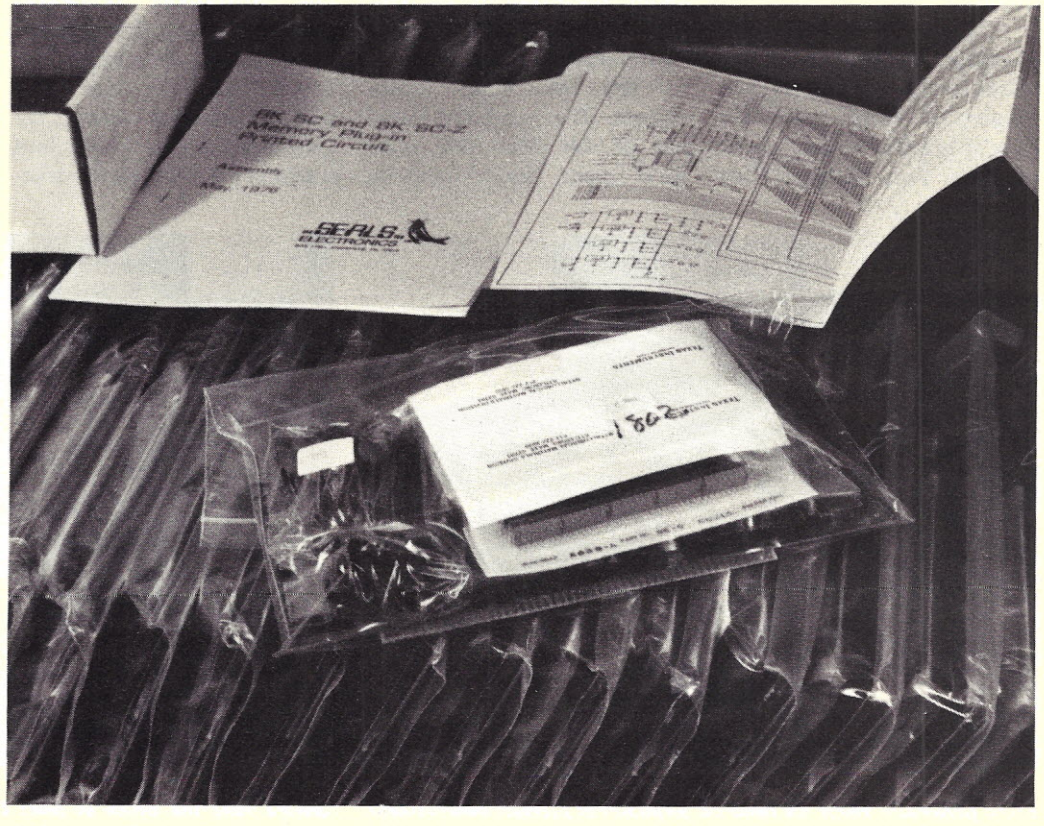
The first 4K memory card has grown into a plethora of Seals products already available or on the way. Interestingly, the 4K card was dropped in favor of the 8K version ("I felt we could get twice the density on the card, and the 4K drew too much current. I thought we could do much better") and was later sold to S. D. Sales. So the 4K memory offered by S. D. Sales is basically the original Seals board which Bruce says still is "a good card."

Because Altair provided the first computer experience, the first Seals boards were built on the Altair bus. But Bruce was afraid to advertise that his boards would work successfully in any Altair bus system until he had built the system and tried it. That's still the Seals policy. They have six machines up and running to test the Seals board compatibility and help the engineers in design work. More computers currently are under construction and check-out and new Seals products are coming out all the time.

By now you've probably read the ads for the 8K memory and other Southwest Tech products, and there's a 4K ROM card set up for fast or slow 1702-As or 5203s. Coming soon, Bruce says, is Seals BASIC on that 4K ROM card, a 16K static memory, an ac I/O card, video interface and more.

Indicative of his confidence in the Seals products, Bruce didn't hesitate to answer my questions about the 16K memory design: "The design is perfect. There's nothing wrong except for supply of those 4200 chips." Sticking with his ten day delivery policy, Bruce refuses even to advertise the new board until he can be assured of enough of the SEMI 4200 memories to meet the expected demand.

"Everything we've got is



A bench full of 8K memory board kits ready for packaging and shipment. Seals guarantees 10-day delivery, but usually an order received by 2 pm goes out the same day via UPS.

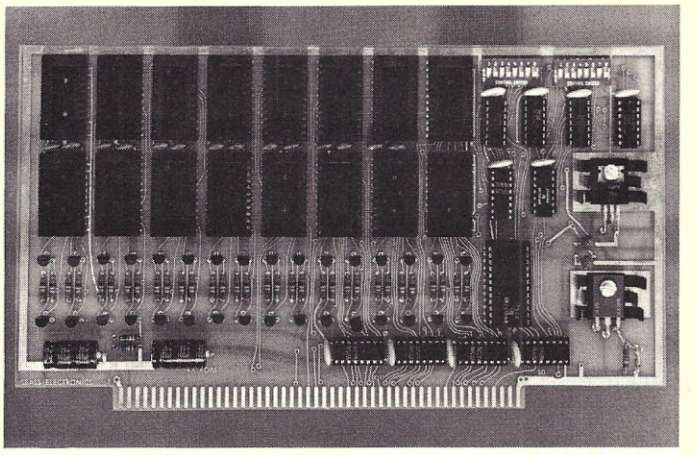
second or third sourced," he says. He requires all of his parts vendors to have impounded inventories at least half of the amount of the blanket order. And he tells dealers: "Just let the quality sell itself."

Why is he so sure of the board's design? That's easy when you hear the procedure to get a product on the market. First, the engineers start from scratch, usually without even having seen anybody else's design. After debugging a wire-wrapped version of the new product, twenty to forty PC boards are made and built up. The prototypes are loaned to area hobbyists and sold to dealers at a discount for evaluation. Some go to the Tennessee Valley Authority's environmental evaluation chamber in Knoxville, others to NASA testing facilities in Huntsville. After thirty to sixty days, input from these tests is evaluated and any design changes are made. Next, perhaps 100 boards are made up. If no problems emerge at this point, full production is begun.

"I'm surrounded by a tremendous amount of design talent in this area and I'm just tapping it," Bruce says. "But they're skeptics at heart, even of their own designs. They want everything perfect." This push for perfection comes from the nuclear instrumentation industry where high density electronics dealing with 500 MHz signals are common.

As if to show his design expertise isn't confined to Tennessee, Bruce dropped a small PC board on the desk. It was a prototype for the new Seals cassette recorder interface from a Cincinnati designer. He told the engineer he had a maximum of 5.1 x 10 inches to work with (the standard Altair board), and he got a 2 x 3 inch board back. The production version may be even smaller because the engineer has since replaced all the components on the board with a single integrated circuit and two potentiometers! It's supposed to operate at speeds up to 1200 baud and will be on the market sometime after July.

Bruce and Sandra Seals are justifiably proud of the reputation for quick delivery and quality products they've built up in a short time. They talk about this aspect of the business freely. It is like pulling teeth, however, to get them to tell me about future designs. The real bomb came out of the clear blue, after we'd spent hours rambling over a variety of subjects:



Already available is this Seals 4K ROM card. It'll take up to 16 1702-As or 5203s, each with its own Vgg clocked for low power consumption, and has switched-selected wait states to accommodate the slowest 1702-A.

"Our Emulator will be out in the fall," Bruce said offhandedly. I didn't say anything. I wasn't sure what he was talking about.

"Yeah," he continued, "It'll use a 3000 series Intel chip with all the individual microprocessor characteristics stored in ROM. It can act like an 8080, a 6800, a Z-80 or even the LSI-11, which is a 16-bit processor."

The ROM instruction set for individual processors could be changed for about thirty bucks, allowing an Emulator owner to run anybody's software simply by unplugging a few ROMs and substituting the new instruction set. Bruce finally mentioned that this Emulator card will be housed in a nice cabinet with power supply, motherboard and I/O for about $500.

Look for the first PUP-1 (for Peripheral Universal Processor, Bruce says, but what's a baby seal ... ?) about October. It'll have only three switches: a key switch for power on-off, and two switches to give the operator some control over reset functions.

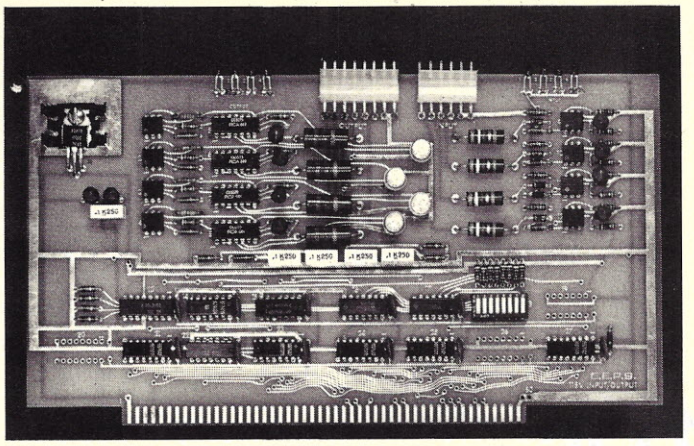
Just as the first Seals memory boards were designed to fill a need Bruce himself felt, the PUP-1 evolved because Seals products now have outlets in England and



Bruce personally keeps his hand on all phases of product development. Here he's checking an overlay for the new 16K memory board — the layout from which the production negative for the memory card is made.



Sandra runs the office at Seals Electronics, and Bruce is content to leave it that way. If you call to place an order or discuss a problem, you'll probably talk with Sandra.



The Seals ac controller has 3,000 volt optical isolation, four I/O lines with LED status lights and can be fully computer controlled.

Canada. There aren't enough computer mainframes from other manufacturers in these countries to support the volume he'd like, so he's introducing his own. And, he promises to continue 10-day deliveries to customers in England and Canada!

"It's not a complicated philosophy, really. Anybody should be able to do it," Bruce says.

But there's a lot behind this simple philosophy. For one thing it's the easy, friendly relationship Bruce and Sandra have with each other — a relationship that seems to infect anyone who is around them. After only a few minutes with them I had trouble remembering that we'd only just met. It's the same way with the people representing their parts and equipment suppliers. Salesmen don't call on Seals Electronics; friends drop by to ask Bruce and Sandra if they need anything. And, they say, things are going to stay that way, even as they prepare to move into a new, larger plant.

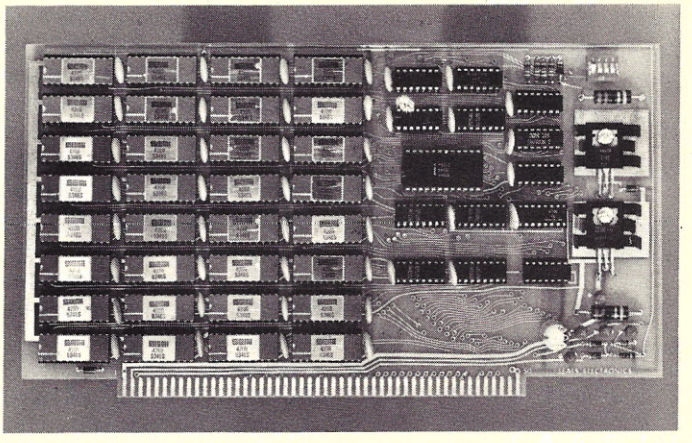
"The attitude and the philosophy of this business is going to stay the same, or we'll restrict our own growth," Bruce promised. "Again, we're just treating people like we want to be treated."

"This is more than just a business for you," I observed.

"There aren't many companies in this business with their own name on it. We're not hiding under a fake name," Bruce responded.

"It's really a thing of the future. It's inevitable," Sandra sparkled, fingering a necklace which is a likeness of a baby seal.

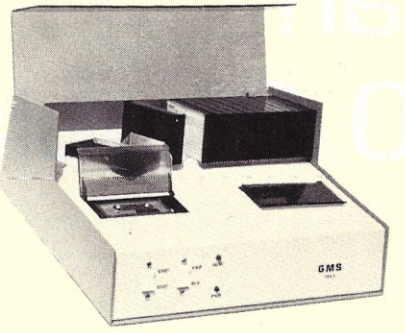
Bruce: "It's our first love." ■



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Try an 8080 Simulator

. . . valuable debugging technique

A simulator is undoubtedly a valuable tool in software troubleshooting, and Lee's article describes one for debugging 8080 code. Now . . . who's going to write one for the 6800 or 6502? Better yet, who's going to get busy and write a simulator for running (not debugging) 6800 code on an 8080 (and vice versa)? I'm really surprised nobody has done it before. If you stop and think about it, the idea makes a lot of sense. Essentially you would have two machines! The software running under the simulator would, of course, run slower, but in most cases this wouldn't be such a big deal ("most cases" being game programs, right?). — John.

So that new program doesn't work. I have found that debugging it usually takes longer than writing it. If only I could see what is going on inside the computer, correcting a program would be a lot easier. The simulator presented here does away with having to guess what is happening. It allows me to single step through a program, and after each instruction, shows me all the internal registers in the microprocessor. In addition, the program being executed can be run until a breakpoint address is reached.

```
A =1234     BC=5678
DE=9ABC     HL=DEFO
PC=0123     SP=4567
   01    1234
   23    5678
   45    9ABC
   67    DEFO
   89    1234
   AB    5678
  *CD    9ABC
   EF    DEFO
   01    1234
   23    5678
   45    9ABC
   67    DEFO
```

Fig. 1. Sample output of the simulator.

	BIT							
	7	6	5	4	3	2	1	0
LXI B	0	0	0	0	0	0	0	1
LXI D	0	0	0	1	0	0	0	1
LXI H	0	0	1	0	0	0	0	1
LXI SP	0	0	1	1	0	0	0	1

Table 1.

The Display

Written for use on an 8080, the display produced by the simulator is shown in Fig. 1. The first three lines show the contents of all the registers. The first two hexadecimal digits after A = is the accumulator, and the next two is the flag register. The first column of numbers is sequential memory bytes starting at six less than the current address of the program's PC register and continuing to PC + 5. The asterisk marks the byte pointed to by PC and is the first byte of the next instruction to be executed. The second column is

stack locations, the first number being the last value pushed onto the stack.

Flowchart

A flowchart of the simulator is shown in Fig. 3. First the length of the instruction pointed to by the PC of the program must be determined. If the instruction is sequential (not a jump, call, or return), it is loaded into the simulator. The registers, with the exception of the PC, are loaded into the microprocessor, and the instruction executed. Non-sequential instructions are not directly executed but are carried out by various software routines. After completion of one instruction the registers are stored. If in breakpoint mode, and the program count does not equal the breakpoint address, the simulator jumps back to the beginning and executes the next instruction. Otherwise, the register contents are displayed and the simulator waits for a keyboard input before continuing.

The Program

A complete listing of the simulator is given in Fig. 2. It should be noted during this discussion that the simulator retains control by never loading the PC register with the actual PC value of the program under execution. The program begins by calling the subroutine LOC, which inputs a four digit hexadecimal starting address from the keyboard. The ASCII digits are converted to binary, and upon return the number is stored in HL. Next a zero is stored in the breakpoint indicator, putting the simulator into single-step mode. The data stored at the stack locations are shown in Fig. 4. Zeroes are also stored at INST and INST + 1, the reason for which will be explained later. Steps 11 through 55 determine the length of the instruction to be executed. As an example consider steps 19 through 20, which determine if the instruction is an LXI. All four LXI instructions are shown in binary in Table 1.

Note that with the exception of bits five and four all the instructions are the same and all combinations of bits five and four are used. The ANI CF at 1D forces bits four and five to zero, causing all the LXI instructions to look like a LXI B. The CPI 01 at 1F checks for an LXI B and a jump is taken if the compare is equal. All the rest of the instructions in this group utilize this same method except the JC at 2F. Prior to this step all the two and three-byte instructions less than CO have been detected so at this point the instruction is one byte in length if it is less than CO.

Let's follow a two-byte instruction. After detection a jump is made to TWOB. TWOB retrieves the two bytes from the program, stores them in the simulator at INST + 1, and INST + 2 and updates HL which contains the program's PC value. The program's new value of PC is stored and the rest of the register values are loaded into the microprocessor. The simulator then falls through to the instruction retrieved from memory and executes it. It also executes a NOP at INST. Recall that zeroes were stored at INST and INST + 1 earlier. A three-byte instruction would use all three locations, and a one-byte would have two NOPs and the one-byte instruction.

Now that the instruction has been executed the internal registers must be stored. But a quandry develops; the only way to obtain the flags is to do a PUSH PSW which would dictate that the value of the stack pointer be stored and then changed first. However, the only way to get this

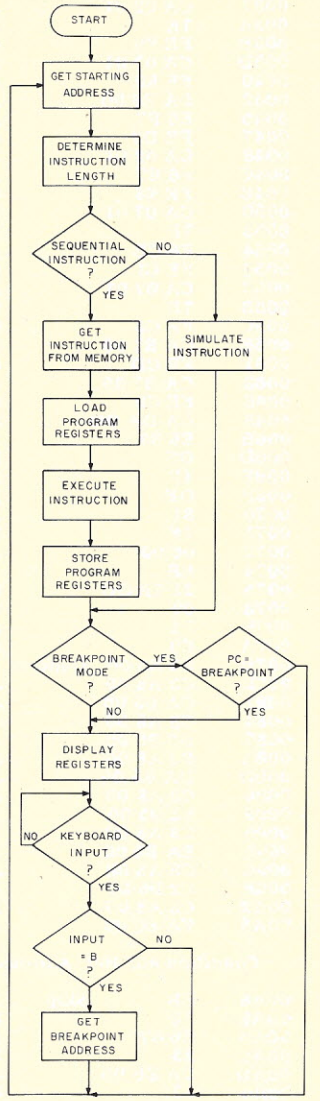


Fig. 3. Flowchart of simulator program.

01E3	Stack	0,1	Breakpoint mode
01E5	Stack	2,3	Breakpoint address
01E7	Stack	4,5	Return address storage
01E9	Stack	6,7	
01EB	Stack	8,9	ASCII address (during DSPY)
01ED	Stack	10,11	Register address (during DSPY)
01EF	Stack	12,13	SP
01F1	Stack	14,15	PC
01F3	Stack	16,17	L,H
01F5	Stack	18,19	E,D
01F7	Stack	20,21	C,B
01F9	Stack	22,23	Flags,A
01FB	Stack	24,25	

Fig. 4. Listing of the data stored at the stack locations.

Fig. 2. Program listing.

Begin Program

0000	31 FD 01		LXI SP, STACK+26	Initialize stack pointer
0003	CD 15 02		CALL LOC	Get starting address
0006	AF		XRA A	A=O
0007	32 E4 01		STA STACK+1	Put program into single step

Begin Execution of Next Instruction, HL = Instruction Address

000A	31 F9 01	Next	LXI SP, STACK+22	Set stack pointer to PSW
000D	AF		XRA A	A=O
000E	32 1C 01		STA INST	Store NOP instruction
0011	32 1D 01		STA INST+1	Store NOP instruction
0014	7E		MOV A,M	Load instruction
0015	E6E7		ANI OE7H	Zero out bits 3 and 4
0017	FE 22		CPI 22H	
0019	CA FD OO		JZ THRB	Jump if LHLD, SHLD, LDA, or STA
001C	7E		MOV A,M	Load instruction
001D	E6 CF		ANI OCFH	Zero out bits 4 and 5
001F	FE 01		CPI 1	
0021	CA FD OO		JZ THRB	Jump if LXI
0024	E6 C7		ANI OC7H	Zero out bits 3, 4, and 5
0026	FE 06		CPI 6	
0028	CA 02 01		JZ TWOB	Jump if MVI
002B	FE C7		CPI OC7H	
002D	CA F4 00		JZ ERST	Jump if RST
0030	FE CO		CPI OCOH	One byte instruction?
0032	DA 07 01		JC ONEB	Jump if less than CO
0035	FE C6		CPI OC6H	

```
0037  CA 02 01        JZ TWOB          Jump if two byte 'immediate'
003A  7E              MOV A,M          Load Instruction
003B  FE F9           CPI OF9H
003D  CA 07 01        JZ ONEB          Jump if SPHL
0040  FE E9           CPI OE9H
0042  CA E8 00        JZ EPCHL         Jump if PCHL
0045  E6 F7           ANI OF7H         Zero out bit 3
0047  FE D3           CPI OD3H
0049  CA 02 01        JZ TWOB          Jump if IN or OUT
004C  E6 E7           ANI OE7H         Zero out bits 3 and 4
004E  FE E3           CPI OE3H
0050  CA 07 01        JZ ONEB          Jump if XCHG, XTHL, EI, or DI
0053  7E              MOV A,M          Load instruction
0054  E6 CB           ANI OCBH         Zero out bits 2, 4, and 5
0056  FE C1           CPI OC1H
0058  CA 07 01        JZ ONEB          Jump if POP or PUSH
005B  7E              MOV A,M          Load instruction
005C  FE C3           CPI OC3H
005E  CA B7 00        JZ EXEC1         Jump if JMP
0061  FE CD           CPI OCDH
0063  CA B7 00        JZ EXEC1         Jump if CALL
0066  FE C9           CPI OC9H
0068  CA DA OO        JZ ERET          Jump if RET
006B  E6 38           ANI 38H          Zero out bits 0, 1, 2, 6, and 7
006D  OF              RRC
006E  4F              MOV C,A          Save in C
006F  OF              RRC
0070  81              ADD C            form values 0, 6, 12, . . . 48 (decimal)
0071  4F              MOV C,A          Save in C
0072  06 00           MVI B,O          B=O
0074  EB              XCHG             Save PC value in DE
0075  21 7B OO        LXI H, COND      Load base address
0078  09              DAD B            Form relative address
0079  F1              POP PSW          Get flags
007A  E9              PCHL             Jump to relative address
007B  C2 B5 00  Cond  JNZ EXEC
007E  C3 A8 00        JMP SKIP
0081  CA B5 00        JZ EXEC
0084  C3 A8 00        JMP SKIP
0087  D2 B5 00        JNC EXEC
008A  C3 A8 00        JMP SKIP
008D  DA B5 00        JC EXEC
0090  C3 A8 00        JMP SKIP
0093  E2 B5 00        JPO EXEC
0096  C3 A8 00        JMP SKIP
0099  EA B5 00        JPE EXEC
009C  C3 A8 00        JMP SKIP
009F  F2 B5 00        JP EXEC
00A2  C3 A8 00        JMP SKIP
00A5  FA B5 00        JM EXEC
```

Condition not Met, Advance PC value to next Instruction

```
00A8  EB        Skip  XCHG             HL = PC value
00A9  7E              MOV A,M          Load instruction
00AA  E6 07           ANI 7
00AC  23              INX H            Increment PC value
00AD  CA EB 00        JZ EPCH1         Jump if return
00B0  23              INX H            Increment PC value
00B1  23              INX H            Increment PC value
00B2  C3 EB 00        JMP EPCH1
```

Condition Met, Execute Instruction

```
00B5  EB        Exec  XCHG             HL = PC value
00B6  7E              MOV A,M          Load instruction
00B7  E6 06     Exec1 ANI 6
00B9  CA DA 00        JZ ERET          Jump if return
00BC  23              INX H            Increment PC value
00BD  5E              MOV E,M          Get address
00BE  23              INX H
OOBF  56              MOV D,M
00C0  EB        Exec2 XCHG
00C1  22 F1 01        SHLD STACK+14    Store new PC value
00C4  31 EF 01        LXI SP, STACK+12 Load SP address for STOR
00C7  FE 02           CPI 2
00C9  CA 38 01        JZ STOR2         jump if jump instruction
00CC  2A EF 01        LHLD STACK+12    Get stack address
00CF  13              INX D            Increment return PC value
00D0  2B              DCX H            Decrement SP value
00D1  72              MOV M,D          Store return PC value in stack
00D2  2B              DCX H
00D3  73              MOV M,E
00D4  31 F1 01        LXI SP, STACK+14 Load SP address for STOR
00D7  C3 37 01        JMP STOR1
```

Process Return

```
00DA  2A EF 01  Eret  LHLD STACK+12    Get stack address
00DD  5E              MOV E,M          Get retun PC value
00DE  23              INX H
00DF  56              MOV D,M
00E0  23              INX H
00E1  31 F3 01        LXI SP, STACK+16
00E4  D5              PUSH D           Store new PC value
00E5  C3 37 01        JMP STOR1
```

Process PCHL

```
00E8  2A F3 01  Epchl LHLD STACK+16    Get HL value
00EB  22 F1 01  Epch1 SHLD STACK+14    Store new PC value
00EE  31 EF 01        LXI SP, STACK+12 Load SP for STOR
00F1  C3 38 01        JMP STOR2
```

register value is to load HL with zero and do a DAD SP, which clears the carry flag causing its original state to be lost. To get around this problem the state of the carry flag is checked by a JC at 125. Either the flag is left cleared after the DAD SP if the JC is not executed, or it is reset after the double add.

Let's now go back and look at those non-sequential instructions. All these instructions must be simulated since the PC cannot be loaded into the microprocessor. The unconditional instructions are singled out first RST, CALL, JMP, and RET. If the instruction is conditional, the simulator must determine whether to execute or skip it. Bits three, four, and five of these instructions are the same for each condition, zero for JNZ, CNZ, RNZ, 001 for JZ, CZ, and RZ etc. All but these three bits are zeroed out by the ANI 38 (hex) at 68. Two RRCs are performed, and the results of the two shifts are added, leaving values of 0, 6, 12, . . . 48 (decimal). This value is added to a base address and the flags are loaded into the microprocessor. A PCHL transfers control to the appropriate pair of jumps. A "no-zero" would go to 78 where, if the condition is met, the JNZ is taken and the instruction executed. Otherwise the following unconditional jump transfers control to the skip location. Similar pairs of jumps check all the other possible conditions.

SKIP updates the PC, one for return and three for jumps and calls, and then proceeds to the breakpoint test. At EXEC returns are first sorted out and handled separately; for a jump or call the next value for PC is retrieved from the program and stored in the location containing the program's PC value. A jump instruction proceeds to the storage routine while a call simulates stack action to store the return address. The returns sorted out earlier also simu-

late the stack to obtain the next PC value. A PCHL loads the value of HL and stores it in the location for PC. An RST puts the call address in DE and then goes to the call routine to be handled like a call instruction.

At 138 a check is made to determine if the simulator is in breakpoint mode. If it is, the previously stored breakpoint address is compared with the current PC value, and if not equal, the next instruction is executed. If equal, or not in breakpoint mode, the DSPY routine is entered. Here three ASCII characters are output to indicate register type; then the CONV routine is called twice to output the register value in hex. To output a CR after every second register pair the loop count in C is checked. Each time it is an odd number the output character count is increased by one, causing a CR to be issued after the spaces.

After all the registers have been displayed the PC and stack values are output. The series of POPs at 182 thru 184 load SP into DE and PC into HL. These values are returned to the stack for storage. At 187 the value of SP is pushed a second time and will be used during the display routine. The PC value is decreased by six and C is loaded with the loop count.

At 18F the output process begins. C is checked and when equal to six an asterisk is output to indicate the instruction to be executed next. One line of output consists of two spaces or an asterisk and a space, the PC value, three spaces, the stack value, and a CR.

Finally the simulator waits for an input before continuing. If the input character is a B, the simulator calls LOC to get the breakpoint address, and in either case jumps to NEXT to begin processing the next instruction.

Using the Simulator

To use the program start at location 0 and input a four

```
                    Process RST
00F4  7E        Erst  MOV A,M          Load Instruction
00F5  E6 38           ANI 38H         Get RST address
00F7  5F              MOV E,A         Put new PC value into DE
00F8  16 00           MVI D,O
00FA  C3 CO OO        JMP EXEC2       Jump to EXEC to finish
                Process Sequential Instructions
00FD  7E        Thrb  MOV A,M         Get first byte
00FE  32 1C 01        STA INST        Store byte
0101  23              INX H
0102  7E        Twob  MOV A,M         Get byte
0103  32 1D 01        STA INST+1      Store byte
0106  23              INX H
0107  7E        Oneb  MOV A,M         Get byte
0108  32 1E 01        STA INST+2      Store byte
010B  23              INX H
010C  22 F1 01        SHLD STACK+14   Store PC value
010F  2A EF 01        LHLD STACK+12   HL = SP value
0112  31 F5 01        LXI SP, STACK+18
0115  D1              POP D           DE = program value
0116  CI              POP B           BC = program value
0117  F1              POP PSW         A and flags = program value
0118  F9              SPHL            SP = program value
0119  2A F3 01        LHLD STACK+16   HL = program value
011C        Inst  DS 3                Execute instruction stored here
011F  22 F3 01        SHLD STACK+16   Store HL
0122  21 00 00        LXI H,O         HL = O
0125  DA 2C 01        JC CARRY        Determine state of carry flag
0128  39              DAD SP          HL = program SP value
0129  C3 2E 01        JMP STOR
012C  39        Carry DAD SP          HL= program value
012D  37              STC             Reset carry flag
012E  31 FB 01  Stor  LXI SP, STACK+24
0131  F5              PUSH PSW        Store A and flags
0132  C5              PUSH B          Store BC
0133  D5              PUSH D          Store DE
0134  31 F1 01        LSI SP, STACK+14
0137  E5        Stor1 PUSH H          Store SP value
0138  3A E4 01  Stor2 LDA STACK+1     Load breakpoint mode indicator
013B  A7              ANA A           Set flags
013C  CA 54 01        JZ DSPY         Jump if not in breakpoint mode
013F  2A F1 01        LHLD STACK+14   Load current PC value
0142  3A E5 01        LDA STACK+2     Load lower byte of breakpoint address
0145  BD              CMP L
0146  C2 OA OO        JNZ NEXT        Jump if addresses not equal
0149  3A E6 01        LDA STACK+3     Load lower byte of breakpoint address
014C  BC              CMP H
014D  C2 OA OO        JNZ NEXT        Jump if addresses not equal
0150  AF              XRA A           A = O
0151  32 E4 01        STA STACK+1     Breakpoint address reached, return to single step mode
0154  21 FA 01  Dspy  LXI H,STACK+23  Load address of registers
0157  E5              PUSH H
0158  21 FD 01        LXI H, ASCII    Load address of headings
015B  OE 06           MVI C, 6        C = loop count
015D  06 03     Dspy1 MVI B, 3        B = output character count
015F  CD 4D 02        CALL OUTPT      Output heading
0162  E3              XTHL            Get register address
0163  CD 2E 02        CALL CONV       Output register value
0166  2B              DCX H
0167  CD 2E 02        CALL CONV       Output register value
016A  2B              DCX H
016B  06 03           MVI B, 3        B = output character count
016D  79              MOV A,C         Check loop count
016E  1F              RAR
016F  D2 74 01        JNC DSPY2       Jump if no CR output
0172  06 04           MVI B, 4        Increase character count for CR
0174  EB        Dspy2 XCHG
0175  21 10 02        LXI H, SPACE    Load output address
0178  CD 4D 02        CALL OUTPT
017B  E1              POP H           Get heading address
017C  D5              PUSH D          Store register address
017D  23              INX H
017E  OD              DCR C           Decrement loop count
017F  C2 5D 01        JNZ DSPY1       Jump if not finished
0182  D1              POP D           Get rid of address
0183  D1              POP D           DE = SP value
0184  E1              POP H           HL = PC value
0185  E5              PUSH H
0186  D5              PUSH D
0187  D5              PUSH D
0188  11 FA FF        LXI D, -6
018B  19              DAD D           HL = PC — 6
018C  OE OC           MVI C, OCH      C = loop count
018E  EB              XCHG
018F  21 10 02  Dspy3 LXI H, SPACE    HL = output address
0192  79              MOV A, C        Check loop count
0193  FE 06           CPI 6
0195  C2 99 01        JNZ DSPY4       Jump if no asterisk output
0198  2B              DCX H           Change address for asterisk
0199  06 02     Dspy4 MVI B, 2        Load output count
019B  CD 4D 02        CALL OUTPT
019E  EB              XCHG
019F  CD 2E 02        CALL CONV       Output PC value
01A2  23              INX H
01A3  EB              XCHG
01A4  06 03           MVI B, 3        Load output count
01A6  21 10 02        LXI H, SPACE
01A9  CD 4D 02        CALL OUTPT      Output spaces
01AC  E1              POP H           Get address of SP
01AD  D5              PUSH D          Store address of PC
01AE  CD 2E 02        CALL CONV       Output SP value
01B1  23              INX H
```

```
01B2  CD 2E 02        CALL CONV
01B5  23              INX H
01B6  D1              POP D           Get PC address
01B7  E5              PUSH H          Store address of SP
01B8  06 01           MVI B, 1        Load count for CR
01BA  21 13 02        LXI H, SPACE+3  HL = address of CR
01BD  CD 4D 02        CALL OUTPT      Output CR
01CO  OD              DCR C           Decrement loop count
01C1  C2 8F 01        JNZ DSPY3       Continue output?
01C4  CD 5C 02        CALL INP        Wait for input
01C7  FE 42           CPI 'B'         Breakpoint?
01C9  C2 DD 01        JNZ CONT        Jump if not breakpoint
01CC  32 E4 01        STA STACK+1     Change breakpoint indicator
01CF  CD 15 02        CALL LOC        Get breakpoint address
01D2  22 E5 01        SHLD STACK+2    Store breakpoint address
01D5  21 13 02        LXI H,SPACE+3   Load CR address
01D8  06 01           MVI B, 1        Load output count
01DA  CD 4D 02        CALL OUTPUT     Output CR
01DD  2A F1 01  Cont  LHLD STACK+14   HL = PC
01EO  C3 OA OO        JMP NEXT
```

Register Storage

```
01E3            Stack  DS 26          Reserve 26 bytes for STACK
```

ASCII Headings

```
01FD  41 20     Ascii  DW 'A '
01FF  3D 42            DW '=B'
0201  43 3D            DW 'C='
0203  44 45            DW 'DE'
0205  3D 48            DW '=H'
0207  4C 3D            DW 'L='
0209  50 43            DW 'PC'
020B  3D 53            DW '=S'
020D  50 3D            DW 'P='
020F  2A               DB '*'
0210  20        Space  DB ' '
0211  20 20            DW '  '
0213  OD OA            DW ODOAH
```

This Routine gets a Four Digit ASCII Address from an Input Device, Converts to Hex and Returns with Value in HL

```
0215  06 04     Loc    MVI B, 4        Load loop count
0217  CD 5C 02  Loc1   CALL INP        Get character
021A  29               DAD H           Shift HL four places
021B  29               DAD H
021C  29               DAD H
021D  29               DAD H
021E  FE 40            CPI 40          Convert to hex
0220  DA 25 02         JC LOC2         Jump if number
0223  C6 09            ADI 9           Add bias to letter
0225  E6 OF     Loc2   ANI OFH         Strip off upper bits
0227  B5               ORA L
0228  6F               MOV L, A        Move to HL register
0229  05               DCR B           Decrement loop count
022A  C2 17 02         JNZ LOC1
022D  C9               RET
```

This Routine Converts the Byte Pointed to by HL from Hex to ASCII and Outputs the two Digits

```
022E  16 02     Conv   MVI D,2         Load loop count
0230  7E               MOV A,M         Get byte
0231  5F               MOV E,A         Store in E
0232  OF               RRC             Shift A four times
0233  OF               RRC
0234  OF               RRC
0235  OF               RRC
0236  E6 OF     Conv1  ANI OFH         Mask out upper bits
0238  FE 0A            CPI OAH
023A  DA 3F 02         JC CONV2        Jump if number
023D  C6 07            ADI 7           Add bias for letter
023F  C6 30     Conv2  ADI 30          Add bias for ASCII
0241  77               MOV M,A         Store character in memory
0242  04               INR B           B = 1
0243  CD 4D 02         CALL OUTPT      Output character
0246  7B               MOV A,E         Move character to A
0247  15               DCR D           Decrement loop count
0248  C2 36 02         JNZ CONV1       Jump if not finished
024B  73               MOV M,E         Restore character to memory
024C  C9               RET
```

This Routine Outputs a String of Characters, B = Number of Characters, HL Points to the Characters

```
024D  DB 02     Outpt  IN 2            Get status
024F  17               RAL
0250  DA 4D 02         JC OUTPT        Jump if not ready
0253  7E               MOV A,M         Get output character
0254  D3 03            OUT 3           Output character
0256  05               DCR B           Decrement loop count
0257  C8               RZ              Return if done
0258  23               INX H           Advance pointer
0259  C3 4D 02         JMP OUTPT
```

This Routine Inputs one Character

```
025C  DB 02     Inp    IN 2            Get status
025E  OF               RRC
025F  DA 5C 02         JC INP          Jump if not ready
0262  DB 03            IN 3            Get character
0264  C9               RET
```

digit hex starting address. The simulator then executes the first instruction and displays the result. The display contains 15 lines, and since my TV typewriter has 16 lines (most systems will need a line feed) a CR returns the cursor to the top of the next page. The simulator interprets the keyboard input as a signal to go ahead and execute the next instruction and output the results. To go into breakpoint mode type a B followed by a four digit hex address. The simulator will continue to execute instructions without display until it comes to the breakpoint address and then revert to single-step mode to display the registers and wait for an input.

Nearly every program must be tailored to the individual system on which it runs. Most users will probably need a CR followed by a line feed to return the cursor or printhead to the beginning of the next line. If this is the case with your system, increment the size of the constants in the MVI B instructions at 172, 1B8 and 1D8. All the input and output routines are at the end of the program so you can easily incorporate other routines such as those used in a monitor, or change the I/O to octal format.

When using the simulator even in breakpoint mode remember the program is being executed at a much slower speed than if it were running alone. Certain real-time applications such as routines with high speed peripherals may not operate properly. Several times I've had a program work using the simulator but fail when run by itself. Every time the problem has been traced to a defective memory chip. When run at full speed as during a stack operation, the memory picked a bit; but when the time between certain memory accesses was changed under the simulator, it worked.

I have found the simulator to be an invaluable trouble-shooting tool and believe you will too. ■

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Build a $20 EPROM Programmer

... for the 5204 4K chip

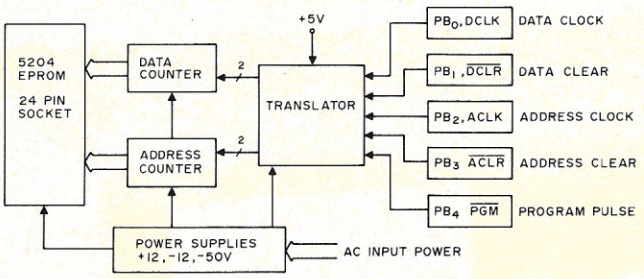


Fig. 1a. Programmer block diagram.

The availability of low-cost electrically programmable read only memory (EPROM) and the convenience of having a few favorite routines permanent as ROM in my KIM system provided the motivation to construct a 5204 EPROM programmer extension for KIM. The programmer design was to be as simple as possible, minimize I/O pin usage, and have its software completely relocatable to allow the routine to install itself in EPROM and be located in KIM unused memory areas without alteration. To reduce the programmer hardware requirement, the decision was made not to read the EPROM during programming as do most commercial programmers. The read EPROM modification to hardware and software could be added later should the need arise. Normally an EPROM will be programmed and then changed to a memory socket in KIM to be tested. Fig. 1a is a block diagram of the programmer and Fig. 1b details the KIM-1 port assignments for interfacing to the programmer.

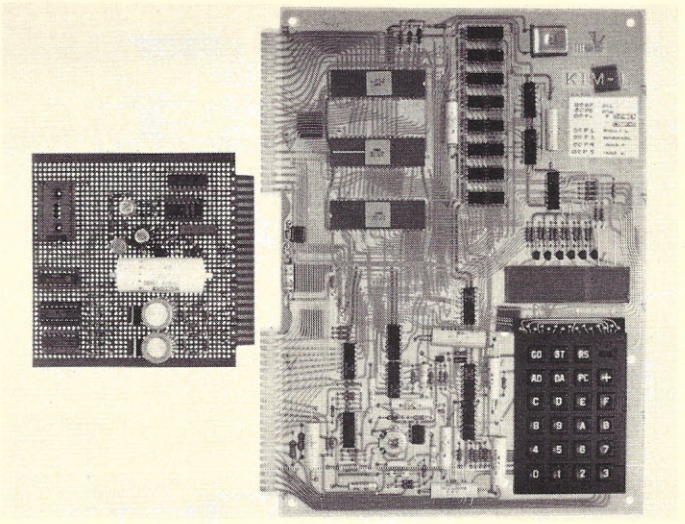
PBDD = ***11111 , * = don't care, PBDD = 1F
PB_0 = $\overline{DCLK}$ Clocks data on positive edge ↑ each transition increments the data.
PB_1 = $\overline{DCLR}$ Clears data to zero on low level. Normally high.
PB_2 = $\overline{ACLK}$ Clocks address on positive going edge ↑ each transition increments the address.
PB_3 = $\overline{ACLR}$ Clears address to zero on low level. Normally high.
PB_4 = $\overline{PGM}$ Provides program pulse to EPROM on low level. Normally high.

PB_7	PB_5	PB_4	PB_3	PB_2	PB_1	PB_0	
*	*	PGM	ACLR	ACLK	DCLR	DCLK	PORT PBD

Fig 1b. KIM-1 port assignments.

Why the 5204 EPROM?

The 5204 EPROM by



KIM-1 and programmer board - a neat combination.

National Semiconductor (MM5204) is a 4K electrically programmable (and erasable) read only memory. The device is a non-volatile memory organized 512 x 8 (½K bytes per chip). The 5204 requires +5 and -12 volt power supplies for ROM operation. Additional noteworthy features are its typical access time of 750 ns typical (1 μs maximum), power saver control for low power applications, and a three state data bus which permits easy memory expansion.

An alternative to the 5204 would be the readily available and inexpensive 1702A EPROM. The 1702A is organized 256 x 8 or ¼K bytes. Its access time is 1 μs maximum, identical to the 5204. The cost of a 1702A is about $7 as compared to $8 for the 5204. An immediate observation is the smaller cost per EPROM byte with the 5204. Naturally, if your requirements call for smaller memory blocks, such as a small system application, the 1702A may be a better choice. The 1702A is slightly more difficult to program due to the requirement to complement addressing during programming. This feature could be easily added to my basic programmer if you chose to modify it for the 1702A. The 1976 Intel Data Catalog is a good reference for the 1702A description and programming.

To access slow memory (access time less than 500 ns) with the 6502 a wait cycle is usually forced during memory read or write. The *MCS6500 Microcomputer Hardware Manual* by MOS Technology, Inc. describes a simple circuit to accomplish this wait cycle in section 2.3.4.1. By experimentation, however, I found that the combination of the 6502 having the address valid extended periods and the typical access time for the 5204 of 750 ns this delay circuit could be deleted. The 5204 EPROM has allowed me to expand KIM -1 with inexpensive ROM without affecting processor speed.

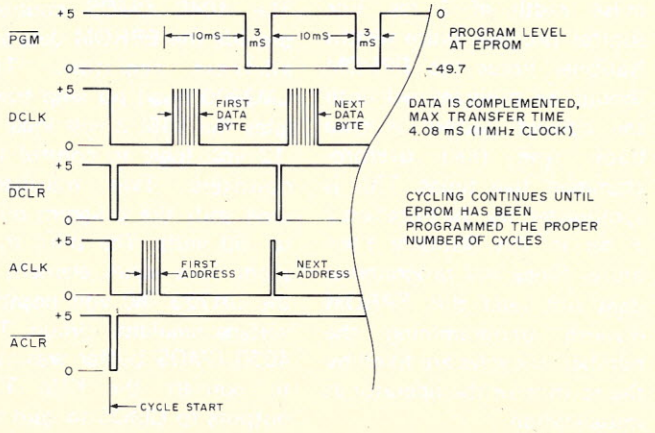


Fig. 2. Programmer timing diagram.

Programming the 5204 EPROM

Much of the literature I dug into discussed programming of the 1702A, 2708, and the 5204. The general concensus seems to be to not apply excessive voltages to prevent catastrophic failures, not to apply extremely fast waveforms to the address and data lines to prevent capacitive coupling internally from damaging the device, and not to apply excessively high duty cycle waveforms during programming to prevent high power dissipation in the device.

One good source of information is the *PROM User's Guide* published by Prolog Corporation. Specific information on the 5204 EPROM may be obtained from National Semiconductor's MOS IC Data Book. Although some conflicting information is in these publications, the general guide lines were followed and in turn, good results obtained. For example, the first National MOS book I used indicated the program pulse width should be between 2.5 ms and 5 ms with a duty cycle of less than 25%. With this data in hand I selected a 3 ms program pulse, an off time of 10 ms, and a 23% duty cycle (see Fig. 2). In a later MOS memory publication National specifies the minimum pulse width as .5 ms. I saw no real reason to alter the timing, however, you may want to save time by adjusting the pulse timers in the routine. All you need do is scale down both times by an equal factor. A word of caution is in order though; be aware that the off period will be affected with less than 4.08 ms (1 MHz clock) off time although the programmer will still operate.

Sockets
1 24 pin dip
2 14 pin dip
3 16 pin dip

Miscellaneous
1 4½" square, .1 inch center, Vero or Vector board
1 44 pin edge connector (use with Vero board)
60 component mounting pins

Discretes
2 100 Ohm 1% ¼W
1 1k Ohm 10% ½W
4 15k Ohm 10% ¼W
1 10k Ohm 10% ¼W
2 2.7k Ohm 10% ¼W
1 5.6k Ohm 10% ½W
9 100k Ohm 5% ¼W
1 100 pF disk cap
2 1.0 uF 50 volt monolithic cap
1 10k Ohm trimpot
8 IN4002 rectifier
1 12 volt, 1 Watt Zener diode
1 2N2905A PNP transistor or eq.
1 2N5287 PNP transistor or eq. (with heat sink)
1 2N1893 NPN transistor or eq.
2 500 uF 35 volt electrolitic cap
1 100 uF 75 volt electrolitic cap
1 7812 +12 volt regulator
1 7912 -12 volt regulator
1 uA723 precision regulator
2 4040 CMOS counter
1 LM3900 Op amp
1 4050 CMOS buffer
2 25.2 VCT transformer (Stancor P8180)

Table 1. Parts list.

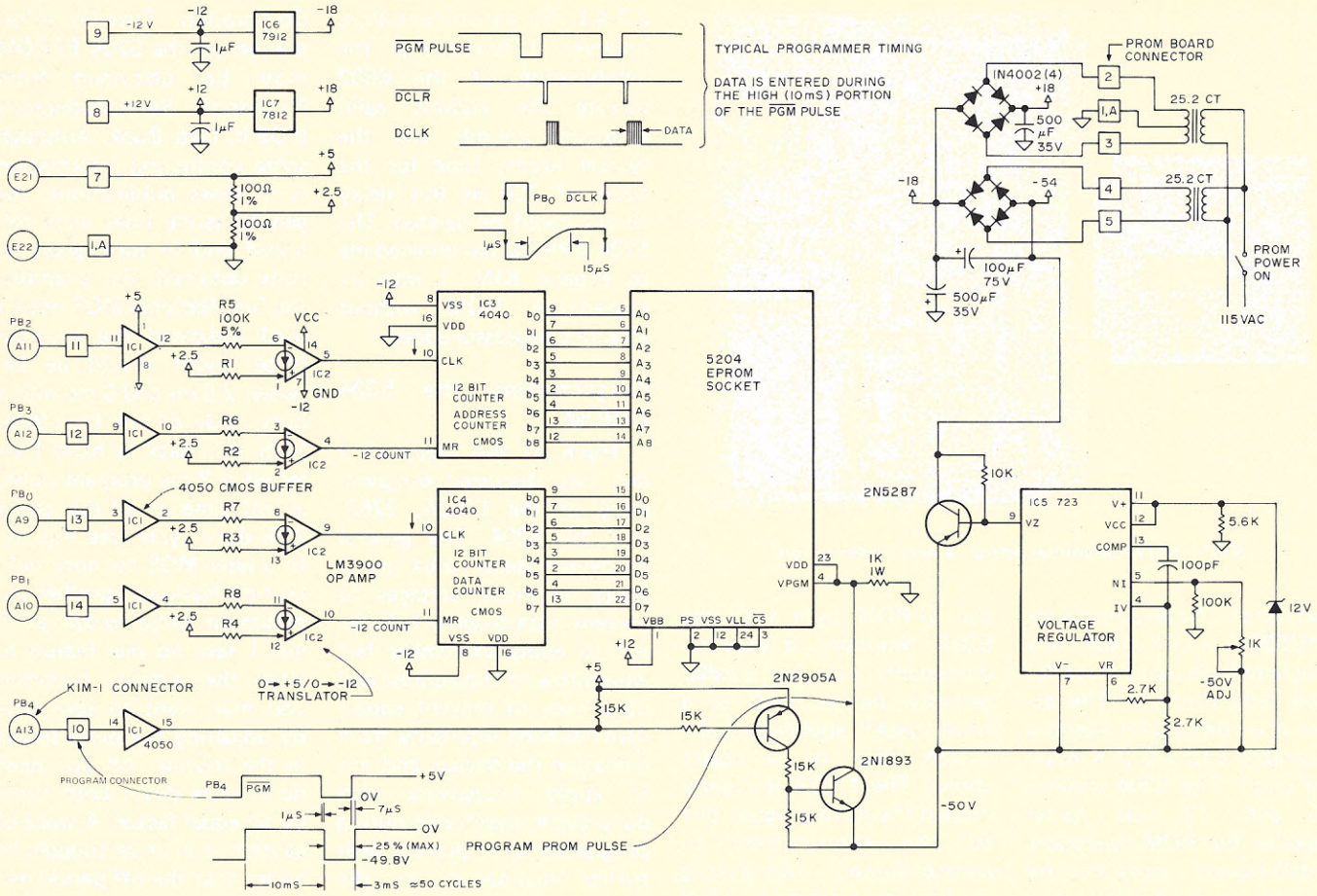


Fig. 3. Schematic diagram of 5204 EPROM Programmer.

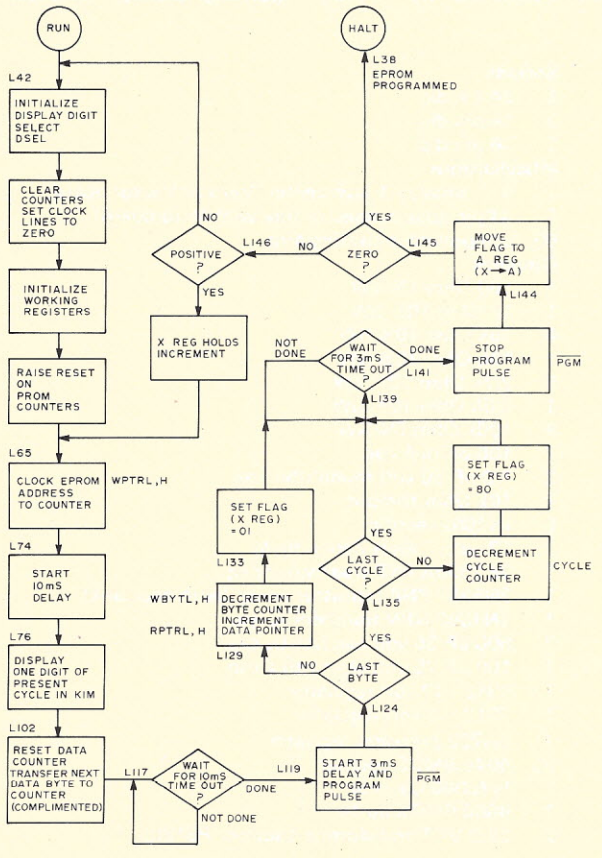


Fig. 4. EPROM Programmer flow diagram.

National suggests the 5204 be overprogrammed sequentially. Overprogramming consists of programming the EPROM in excess of the number of program cycles actually required to establish the correct data pattern. National states that each address location must be programmed for a minimum of 32 cycles with a pulse width of 5 ms or 64 cycles as the pulse width reaches 2.5 ms. I selected 50 cycles for a pulse width of 3 ms. For shorter program pulse widths National notes the EPROM should be programmed until the correct pattern is read back and then overprogrammed five times. This is symbolized by the notation x + 5x in the National literature. Since my programmer does not read this EPROM during programming the number of cycles are fixed by the routine or the operator at initialization.

The results of the technique used here have been satisfying and successful. To date I have 100% programmed a dozen EPROMS without a problem, except for one defective EPROM, which was replaced by the supplier at no charge.

The Programmer Circuit

The circuit shown in Fig. 3 contains three regulator circuits with rectifiers for providing + 12, - 12, and - 50 volts for the programmer. The 4040 CMOS counters provide the EPROM data and address registers. The LM3900 quad op amp translates the KIM 5 volt logic to -12 volt logic to control the counters. Two transistors level shift the program pulse to -50 volts. The third transistor is a series element in the uA723 -50 volt negative voltage regulator circuit. The 4050 CMOS buffer was used to convert the KIM TTL outputs to CMOS to gain the additional voltage swing pro-

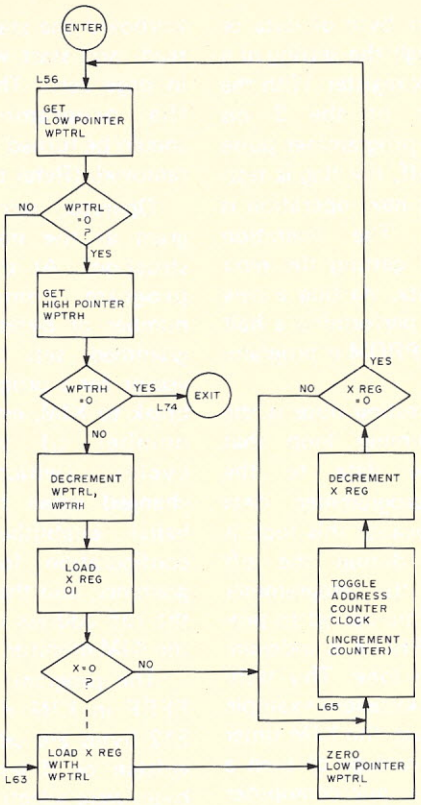


Fig. 5. Increment EPROM address routine flowchart.

vided with CMOS for increased reliability in the voltage translation process.

The address and data counters are operated identically. The counter is reset and then clocked until it contains the proper bit pattern for programming. The address is initialized and incremented to the cycle end. The data counter has the proper data pattern toggled in after being complemented by the programmer routine. The 5204 requires complemented data during programming.

Construction

My board is constructed on a 4½" x 4½" Vero board which was cut down from a standard 4½" x 6" 44 pin Vero proto board (#10290/FG W44/74). The sockets and components used were non-critical; however, the EPROM socket should be a type that allows the EPROM easy entry and removal. Most economical sockets will fill the requirement. A zero force type socket that is used on commercial programmers would be ideal and expensive. A standard Augat wire-wrap socket (Augat #324-AG2F) works fine. It all depends if you're going to program thousands of EPROMS. If you are, you should probably purchase one of the zero force type sockets.

The circuit board power supply rectifiers and regulators are shown in the photos. The transformers, which came from my scrap pile, are mounted adjacent to the card support. The discrete components are all parts which were readily available and are non-critical in nature. The only requirements on the transistors are that they have a breakdown voltage in excess of 50 volts and be capable of dissipating a couple of Watts. The -50 volt regulator series pass transistor should have a small heatsink. If one is not available, fabricate one out of a thin sheet of copper or aluminum.

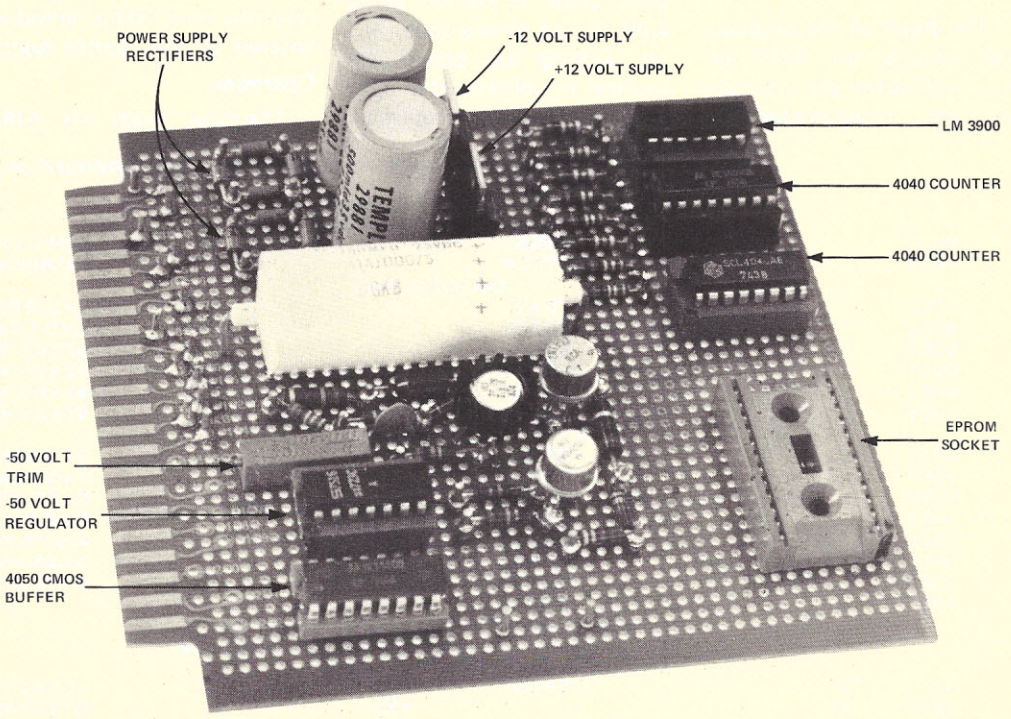
The complete parts complement should cost about $20 excluding EPROMS.

About the Program

The first usage of the program was to program an EPROM with itself to allow the EPROM routine to reside in KIM memory as ROM. I also felt that the program would serve more systems if it is independent of where it resides. You may, for instance want to relocate it from a cassette into different portions of RAM so as not to disturb the program you want to enter into EPROM.

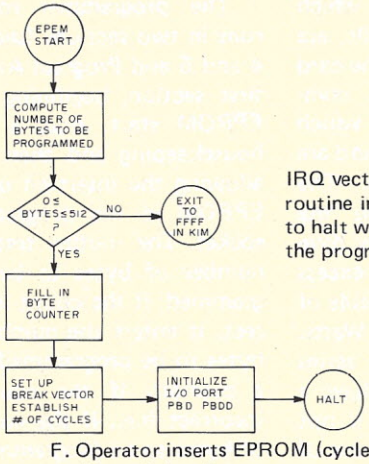
The programmer routine runs in two sections (see Fig. 4 and 5 and Program A). The first section, beginning with EPROM start, does a little housekeeping and then halts allowing the insertion of the EPROM in the programmer socket. The routine tests the number of bytes to be programmed; if the count is correct, it enters the number of bytes to be programmed into a counter. If the count is incorrect (i.e., if the number of bytes to be programmed is less than zero or greater than ½K), the routine exits to display FFFF in the KIM monitor. Then the break vector is established, the number of cycles is set to 50, and the I/O port to the programmer is initialized. After this the programmer routine halts in the KIM monitor at the first instruction in the next section (run, L42) of the routine.

The halt allows power down of the programmer to permit the EPROM to be installed in the socket. Power



5204 EPROM Programmer board.

A. Turn off EPROM power
B. Enter memory source start address
C. Enter memory source stop address
D. Enter EPROM destination start address
E. Start program at start address



IRQ vector points to save routine in the KIM monitor to halt with KIM displaying the programmer run address.

Exit to KIM monitor with break

F. Operator inserts EPROM (cycles or other adjustments may be made here)
G. Turn on EPROM power
H. Start program (push go) at run

Fig. 6. Running the programmer.

is then restored and the EPROM may now be programmed. Running the routine, at the RUN location, programs the EPROM. While this program runs the present cycle is displayed in the KIM data digits, in hexadecimal, with the address digits dark. When finished the routine halts again at the RUN address. The programmer may now be powered down and the programmed EPROM removed.

The heart of the programmer routine, the RUN section, initializes the counters on the programmer for address and data entry. The address is entered to the programmer followed by the start of the off period of the programmer 10 ms pulse. During this delay one of the digits of the cycle is displayed and the data is transferred from the RAM byte specified to the EPROM data counter. The routine then waits for the end of the 10 ms period.

At the end of the 10 ms period, the programmer program pulse is started along with the on period time of 3 ms. During this period the routine establishes the next operation by setting pointers to the next byte of data or cycle through the setting of a flag in the x register. With the termination of the 3 ms period the programmer pulse is turned off, the flag is tested, and the next operation is performed. The operation consists of getting the next byte of data, starting a new cycle, and performing a halt when the EPROM is programmed.

An interesting note is the time consuming loop that clocks the data to the EPROM programmer data counter. Because this loop is completed during the off period of the programmer pulse the time period to program an EPROM is independent of this loop. This technique is an excellent example of how to use the KIM timer and the advantage of such a timer in a microcomputer system. The computer may do other tasks during waiting periods as long as you're back within the time period. With KIM the timer can easily be programmed to interrupt should uncertainties develop in the time required to complete the assigned tasks. Also, since the cycle digit is displayed during this 10 ms period, the digit stays on until the next 10 ms period is entered or the routine halts.

Operation

Operator loads via KIM keyboard the start read, end read, and start write address in page zero. The power to the programmer circuit should be turned off, EPROM removed. (Refer to Fig. 6.)

Operator starts the program at the start (first instruction). At this time the program computes the number of bytes to be programmed, sets up the $\overline{\text{IRQ}}$ vector for a program stop on break to KIM, establishes the number of programmer cycles, (which may be changed when the program halts) establishes the I/O configuration for the programmer, and then halts with the run address displayed by the KIM monitor.

The program will exit to FFFF in KIM if more than 512 bytes are selected to be written or if less than zero bytes were selected.

When the program halts, the number of cycles may be altered if desired.

The next step is to plug a 5204 EPROM into the programmer socket, turn on the programmer power, and then start the program (push go at the displayed address; run).

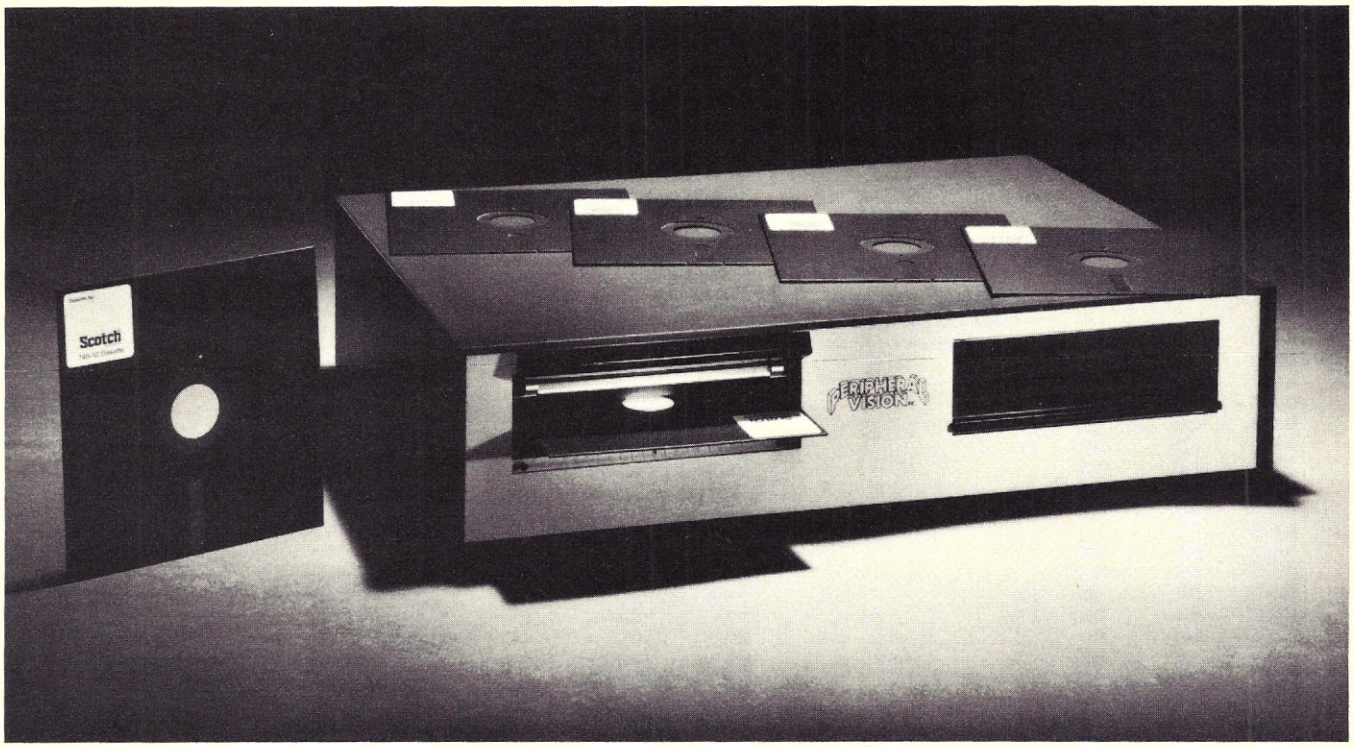
The cycles are counted down and displayed in the KIM display (in hexadecimal). The program halts back at the run address. Turn off the programmer, remove the programmed EPROM. ■

Program A. 5204 EPROM Programmer software routine (continued on page 76).

```
                                    Page Zero Registers
                                Cycle and Display Counters
00DF                        DSEL    DISPLAY DIGIT SELECT CODE
00E0                        CYCLE   NUMBER OF PROGRAM CYCLES
                                    Instruction Data
00E1                        ERAL    END READ ADDRESS LOW
00E2                        ERAH    END READ ADDRESS HIGH
00E3                        SRAL    START READ ADDRESS LOW
00E4                        SRAH    START READ ADDRESS HIGH
00E5                        SWAL    START WRITE ADDRESS LOW
00E6                        SWAH    START WRITE ADDRESS HIGH
                                    Working Registers
00E7                        BYTL    NUMBER OF PROGRAM LOW BYTES
00E8                        BYTH    NUMBER OF PROGRAM HIGH BYTES
00E9                        RPTRL   NEXT BYTE POINTERS
00EA                        RPTRH   FOR DATA SOURCE
00EB                        WPTRL   WRITE POINTERS FOR EPROM
00EC                        WPTRH   ADDRESS START
00ED                        WBYTL   BYTE COUNT WORKING REGISTERS
00EE                        WBYTH

                    Initialize routine: Establish data pointers, check
                    for number of bytes 0 ≤ bytes ≤ 512 establish cycles,
                    stop at program EPROM start address
0200  D8            EPGM   CLD             START PROGRAM
0201  38                   SEC             DETERMINE NUMBER
0202  A5   E1              LDA   ERAL      OF BYTES
0204  E5   E3              SBC   SRAL      TO
0206  85   E7              STA   BYTL      BE
```

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```
0208  A5  E2          LDA  ERAH   PROGRAMMED
020A  E5  E4          SBC  SRAH
020C  10  03          BPL  L26    TEST IF NEGATIVE
020E  4C  29  19  L25  JMP  FFFF   SOMETHINGS WRONG, EXIT
0211  C9  02      L26 CMP  02     TEST IF ⩾ 512
0213  10  F9          BPL  L25    EXIT IF POSITIVE (02 OR MORE)
0215  85  E8          STA  BYTH   ELSE, STORE
0217  18              CLC
0218  A9  00          LDA  00     SET UP
021A  8D  FE  17      STA  17FE   BREAK
021D  A9  1C          LDA  1C     VECTOR
021F  8D  FF  17      STA  17FF   TO POINT AT STOP ROUTINE
0222  A9  31          LDA  31     INITIALIZE NUMBER
0224  85  E0          STA  CYCLE  OF CYCLES TO 50
0226  A9  1F          LDA  1F     ESTABLISH OUTPUT
0228  8D  03  17      STA  PBDD   PORT AND
0223  A9  10  STOP    LDA  10     SET OUTPUT
022D  8D  02  17      STA  PBD    STATUS
0230  00              BRK         BREAK WITH (RUN)
0231  00                          NEXT ADDRESS IN KIM

      Program EPROM routine, initialize routine
      stops at run for EPROM setup in
      programmer circuit

0232  A9  00      RUN LDA  00     INITIALIZE
0234  85  DF          STA  DSEL   DIGIT SELECT
0236  A9  F0          LDA  F0     CLEAR COUNTERS
0238  2D  02  17      AND  PBD    READY CLOCKS
023B  8D  02  17      STA  PBD
023E  A2  06          LDX  06     RESTORE
0240  B5  E2      L48 LDA  L4,X   WORKING
0242  95  E8          STA  L10,X  REGISTERS
0244  CA              DEX
0245  D0  F9          BNE  L48
0247  A9  0A          LDA  0A     RAISE RESETS
0249  0D  02  17      ORA  PBD    ON
024C  8D  02  17      STA  PBD    COUNTERS
024F  A0  00          LDY  00     ZERO Y (X = 0)
0251  A5  EB      L56 LDA  WPTRL  GET LOW POINTER FOR INCREMENT
0253  D0  0C          BNE  L63    IF NOT ZERO INCREMENT COUNTER
0255  A5  EC          LDA  WPTRH
0257  F0  21          BEQ  L74    EXIT IF ZERO
0259  C6  EB      L60 DEC  WPTRL  ELSE, INCREMENT
025B  C6  EC      L60A DEC WPTRH  TO NEXT
025D  A2  01      L61 LDX  01     PAGE
025F  D0  04          BNE  L65
0261  A6  EB      L63 LDX  WPTRL
0263  84  EB          STY  WPTRL  ZERO WPTRL
0265  A9  FB      L65 LDA  FB     ENTER HERE FOR 1 STEP
0267  2D  02  17      AND  PBD    WITH X = 01
026A  8D  02  17      STA  PBD
026D  A9  04          LDA  04
026F  0D  02  17      ORA  PBD
0272  8D  02  17      STA  PBD
0275  CA              DEX
0276  D0  ED          BNE  L65
0278  F0  D7          BEQ  L56

      Start 10 ms delay, display cycle digit

027A  A9  9C      L74 LDA  9C     START 10ms DELAY
027C  8D  06  17      STA  ÷64    (1706)
027F  A9  7F          LDA  7F     SET UP SEGMENT PORT
0281  8D  41  17      STA  PADD1  FOR OUTPUT
0284  8E  40  17      STX  PAD1   X = 0 FROM ABOVE, SEGMENTS OUT
0287  8E  42  17      STX  PBD1   TURN OFF DIGIT
028A  A5  DF          LDA  DSEL   SELECT DIGIT TO BE DISPLAYED
028C  D0  13          BNE  L91    BRANCH TO DISPLAY HIGH DIGIT
028E  A9  12          LDA  DIG 1  LOAD 12  FOR LOW DIGIT
0290  8D  42  17      STA  PBD1   SELECT DIGIT
0293  A9  0F          LDA  0F
0295  25  E0          AND  CYCLE  GET LOW DATA
0297  E6  DF          INC  DSEL   SELECT NEXT DIGIT
0299  D0  13          BNE  L99    ALWAYS NOT EQUAL TO ZERO
029B  F0  8E      STOP 1 BEQ  STOP   INTERMEDIATE STOP BRANCH
029D  10  C6      L89 BPL  L65    INTERMEDIATE BRANCH
029F  30  91      RUN 1 BMI  RUN  INTERMEDIATE RUN BRANCH
02A1  A9  10      L91 LDA  DIG2   LOAD 10 FOR HIGH DIGIT
02A3  8D  42  17      STA  PBD1   SELECT DIGIT
02A6  A5  E0          LDA  CYCLE  GET HIGH
02A8  4A              LSR         DIGIT
02A9  4A              LSR         OF CYCLE DATA
02AA  4A              LSR
02AB  4A              LSR
02AC  C6  DF          DEC  DSEL
02AE  A8          L99 TAY
02AF  B9  E7  1F      LDA  ABS, Y GET CONVERSION DATA
02B2  8D  40  17      STA  PADD   TURN ON SEGMENTS

      Get data byte to EPROM data counter,
      wait for end of 10 ms pulse,
      start 3 ms EPROM program pulse

02B5  A9  FD          LDA  FD     RESET DATA COUNTER
02B7  2D  02  17      AND  PBD
02BA  8D  02  17      STA  PBD
```

```
02BD  A9  02        LDA  02
02BF  0D  02 17     ORA  PBD
02C2  8D  02 17     STA  PBD
02C5  A9  FF        LDA  FF          GET COMPLEMENTED
02C7  A0  00        LDY  00          DATA
02C9  51  E9        EOR  (IND),Y     FOR COUNTER RPTRL
02CB  F0  0A        BEQ  L117        EXIT IF DATA IS ZERO
02CD  AA            TAX              ELSE INCREMENT COUNT
02CE  EE  02 17  L113  INC  PBD
02D1  CE  02 17     DEC  PBD         (4.08ms LOOP MAX WITH 1 MHz CLOCK)
02D4  CA            DEX
02D5  D0  F7        BNE  L113
02D7  AD  07 17  L117  LDA  1707     GET TIMER STATUS
02DA  F0  FB        BEQ  L117        IF NOT DONE, CHECK
02DC  A9  30        LDA  30          START 3ms TIME
02DE  8D  06 17     STA  ÷64         FOR PROGRAM PULSE
02E1  A9  EF        LDA  EF
02E3  2D  02 17     AND  PBD
02E6  8D  02 17     STA  PBD         START PULSE

        Test for last byte, last cycle, wait
        for 3 ms time-out. Stop program pulse

02E9  E4  ED        CPX  WBYTL
02EB  D0  06        BNE  L129
02ED  E4  EE        CPX  WBYTH
02EF  F0  0E        BEQ  L135        BOTH ZERO BRANCH TO TEST CYCLE
02F1  C6  EE        DEC  WBYTH
02F3  C6  ED     L129  DEC  WBYTL
02F5  E6  E9        INC  RPTRL
02F7  D0  02        BNE  L133
02F9  E6  EA        INC  RPTRH
02FB  A2  01     L133  LDX  01        SET FLAG AND WAIT
02FD  D0  08        BNE  L139        FOR TIME OUT, FLAG = 01, POS
02FF  E4  E0     L135  CPX  CYCLE
0301  F0  04        BEQ  L139        WAIT FOR TIME OUT FLAG = 00
0303  C6  E0        DEC  CYCLE
0305  A2  80        LDX  80
0307  AD  07 17  L139  LDA  1707     TEST FOR TIME OUT
030A  F0  FB        BEQ  L139
030C  A9  10        LDA  10          STOP PROGRAM
030E  0D  02 17     ORA  PBD         PULSE
0311  8D  02 17     STA  PBD
0314  8A            TXA              GET FLAG FOR TEST
0315  F0  84        BEQ  STOP1       IF ZERO, ALL DONE, EXIT AT START
0317  10  84        BPL  L89         BRANCH IF POSITIVE TO INC. ADDRESS
0319  30  84        BMI  RUN1        RUN NEXT CYCLE
```


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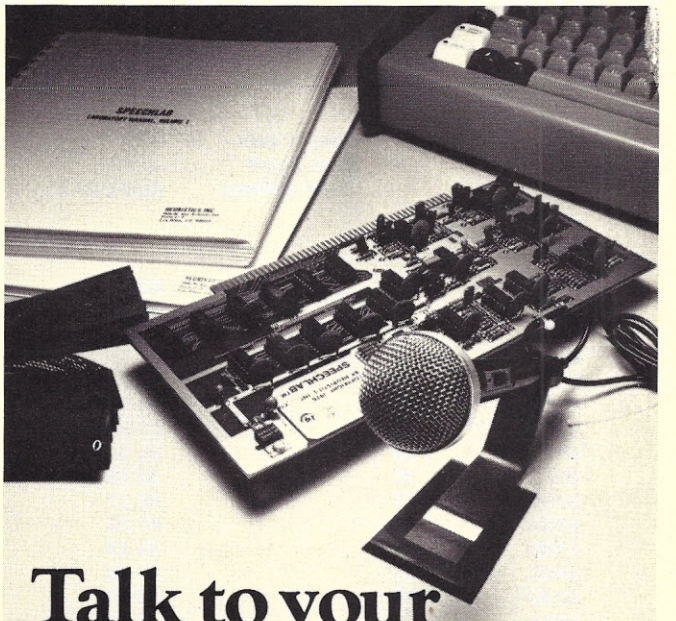
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In the PUNCH (write data to cassette) and LOAD (read data from cassette) routines of the MIKBUG monitor, two-byte ASCII characters are used to represent one byte of data. This requires 50% more time to punch/load than is really necessary. MIKBUG also produces records containing a maximum of 16_{10} data bytes. This is inefficient (with regard to speed) since each record, regardless of length, requires ten bytes of overhead (two header bytes, two size bytes, four address bytes and two checksum bytes).

How do we improve on this? First we don't record ASCII characters, we record the whole byte just the way it is, in binary. It will look like a lot of garbage when it comes out on the terminal, but we don't need it anyway. Second, we don't output just 16_{10} bytes per record; we use 255 bytes per record.

We can see this a little better by referring to Table 1. The memory address and contents are shown in the first two columns. In order to save the data between location 0100 and 0111 MIKBUG will require two data records. It will require a total of 56_{10} bytes of information to save this data. The binary routines, however, require only one data record and a total of 23_{10} bytes of information to save the same data. The main difference between the two formats is that MIKBUG converts each data byte into its equivalent ASCII form; whereas, the binary routines simply transfer the data bytes in their original *binary* form (hence the name Binary Punch/Loader). This is what makes the output unreadable on an ASCII device.

The other advantage of the binary routines over MIKBUG is that MIKBUG limits its record length to 16_{10} data bytes. The binary routines are limited by the eight-bit byte (or rather, the highest count which can be obtained with eight bits) which is FF_{16} or 255_{10} data bytes. With the binary routines there is a six-byte overhead for each record of 255_{10} data bytes; whereas, MIKBUG has a ten-byte overhead for each record of 16_{10} data bytes.

I have found it best to use this new binary format as a complement to, rather than a replacement for the MIKBUG format. The main reason is that the MIKBUG format is well-established and widespread with many programs available in this format. I simply load these programs using MIKBUG, then save them on another tape in the binary format. This allows for faster loading the next time I wish to run the program. Since the two formats are not compatible with each other it is necessary to identify on the cassette which is in MIKBUG and which is in binary format, but since each tape contains a copy of the binary loader (in MIKBUG) there is no problem of incompatibility at load time.

			MIKBUG Record(Hex)	ASCII Output	Binary Record(Hex)
		Header Byte	52 31	S1	58 31
		Byte Count	31 33	13	12
		Begin Address	30 31 30 30	0100	01 00
Address	**Contents**				
0100	21		31 31	21	21
0101	35		33 35	35	35
0102	F0		46 30	F0	F0
0103	A5		41 35	A5	A5
0104	94		39 34	94	94
0105	68		36 38	68	68
0106	73		37 33	73	73
0107	52		35 32	52	52
0108	25		32 35	25	25
0109	F1		46 31	F1	F1
010A	A0		41 30	A0	A0
010B	33		33 33	33	33
010C	FF		46 46	FF	FF
010D	0F		30 46	0F	0F
010E	E0		45 30	E0	E0
010F	12		31 32	12	12
		Checksum	35 36	56	
		Header Byte	52 31	S1	
		Byte Count	30 35	05	
		Begin Address	30 31 31 30	0110	
0110	01		30 31	01	01
0111	00		30 30	00	00
		Checksum	45 38	E8	C1
Total Bytes Output			56		23

Table 1. MIKBUG versus binary format.

Punch — New Version

Before we can load a program with this method, we

first have to write one to tape. We do this with the PUNCH BINARY program shown in Program 1. To make things easier at load time the first thing we want to do is save the start address of the program.

Lines 50-130 ask for and save the start address of the program. This address will be put in location A048-A049 at load time.

Lines 140-190 clear the screen, print directions, and prompt with an @ for the beginning and end memory locations to be saved.

Lines 200-290 set the number of bytes for the record and check for the end address.

Lines 300-330 generate the header for each record.

Line 340 clears the checksum.

Lines 350-360 write the number of bytes in the record.

Lines 370-390 write the start address of the record.

Lines 400-430 write each byte of the record.

Lines 440-470 write the checksum for the record.

Lines 480-500 check to see if all is finished; if not go back to PUN11 and start the next record. If all is done, go back to START. If we want to save another block of memory, enter the begin and end address of this new block. If we are finished, switch the AC-30 cassette interface to the local mode and enter X9. This is the end of file record.

Lines 510-560 is the subroutine to add the next byte to the checksum, output the byte, via OUTEE, and increment the index register for the next byte.

Now the program is saved on tape. To read it back into memory, the LOAD BINARY program (Program 2) is used.

Load – New Version

Lines 1040-1110 read the tape and look for a header record. If it finds an end of file record (X9), processing is complete and control is transferred to the monitor. If it finds a data record (X1), processing continues at BL1.

Line 1120 clears the checksum.

Lines 1130-1140 read in the byte count for this record.

Lines 1150-1180 read in the start address for this record.

Lines 1190-1260 read in and check each of the data bytes. If an error occurs in storing the data, a branch is made to BL3 to abort processing.

Lines 1270-1290 read in and check the checksum. If an error has occurred, processing is terminated.

Line 1300 transfers control back to the monitor if an error has occurred.

Lines 1310-1370 is a subroutine to read in one data byte and update the checksum.

Lines 1380-1560 is a subroutine to replace the MIKBUG "INEE". It is required since the MIKBUG routine masks out the high order bit when it reads in an ASCII character. We want to retain this bit because we are using the whole byte.

Lines 1570-1580 define three bytes of storage; one for the checksum and two for the start address of the record.

```
010                NAM    PUNCH BINARY
020                OPT    O,S
030                ORG    $1E00
040     BEGIN      LDS    #$A047      move stack
050                LDX    #DIR        print request
060                JSR    $E07E       PDATA1
070                JSR    $E047       BADDR get start address
080                STX    $A048       store
090                LDX    #$A048      load this address
100                STX    $A002       as begin location
110                LDX    #$A049      load this address
120                STX    $A004       as end location
130                BRA    GO          go write this to tape
140     START      LDX    #CLR        home,clear,prompt with "@"
150                JSR    $E07E       PDATA1
160                JSR    $E047       BADDR get begin location
170                STX    $A002
180                JSR    $E047       BADDR get end location
190                STX    $A004
200     GO         LDX    $A002       move begin address
210                STX    $A00F       to temp
220     PUN11      LDAA   $A005       check for end
230                SUBA   $A010       location to
240                LDAB   $A004       see if we
250                SBCB   $A00F       can write
260                BNE    PUN22       256 bytes else
270                CMPA   #$FE        calculate how
280                BCS    PUN23       many bytes
290     PUN22      LDAA   #$FE        left to write
300     PUN23      STAA   $A011       save frame count this record
310                STAA   $A00E       save byte count this record
320                LDX    #MTAPE      write CR/FL,null,null,X1, record header
330                JSR    $E07E       PDATA1
340                CLRB               zero checksum
350                LDX    #$A011      write frame count
360                BSR    PUNT2
370                LDX    #$A00F      write start address for this record
380                BSR    PUNT2
390                BSR    PUNT2
400                LDX    $A00F       load start location this record
410     PUN32      BSR    PUNT2       write byte to tape
420                DEC    $A00E       decrement byte count this record
430                BNE    PUN32       if not done goto PUN32
440                STX    $A00F       save address for next record
450                COMB               set checksum
460                TBA                move checksum to A reg
470                JSR    $E1D1       OUTEE write checksum to tape
480                CPX    $A004       check for end location
490                BNE    PUN11       if not done goto PUN11
500                BRA    START       all done
510     *          SUBROUTINE TO OUTPUT DATA
520     PUNT2      ADDB   X           add byte to checksum
530                LDAA   X           load A reg with byte to output
540                JSR    $E1D1       OUTEE output to tape
550                INX                increment for next byte
560                RTS                return
570     CLR        FDB    $1316       home up, erace to end of frame
580                FCC    /INPUT BEGIN,END ADDRESS FOR SAVE/
590                FCB    $D,$A,$40,4 home, EOF,"@"
600     MTAPE      FCB    $D,$A,,,'X,'1,4  CR,LF,null,null,X,1 header record
610     DIR        FDB    $1316       home,EOF
620                FCC    /INPUT PROGRAM START ADDRESS/
630                FCB    $D,$A,$40,4 CR,LF,"@"
640                END
```

Program 1. PUNCH binary program.

How to Use the Binary Dump/Load Programs

This program was written for the SWTPC 6800 computer using the SWTPC TVTII and the SWTPC AC-30 cassette interface. For any other configuration, modification to the procedures may be required; however, the basic program should remain the same.

I have found it best to have both routines saved, along with their starting address, in MIKBUG format on the same tape, with the load routine first. This way I first load the program to be saved into memory. Then read in the LOAD program with MIKBUG. I then put a blank tape in the cassette recorder and save this LOAD routine, along with its starting address, out to tape with MIKBUG. I then switch the cassette interface to the local mode and enter S9 G, then stop the recorder. Now I load in the PUNCH program with MIKBUG and enter G. I then get the command INPUT PROGRAM START ADDRESS and @ on the TVTII. At this point it is important to move the status switches on the AC-30 cassette interface to off for the read and on for the record functions. This is necessary because the PUNCH program will be outputting bytes which would be decoded by the interface to start and stop the reader and recorder. Once the recorder has started I enter the start address of the program. Next the command INPUT BEGIN, END ADDRESS FOR SAVE will be printed. I simply enter the begin and end address of the block of memory to be saved. The program will then start to output characters which will make you think something is wrong. This output is normal since it is outputting eight-bit binary words for which there is no ASCII equivalent.

When the save is complete the command INPUT BEGIN, END ADDRESS FOR SAVE will again be displayed. If there is another block to be saved, just enter the begin and end address for this new block. If nothing more is to be saved, switch the AC-30 interface to the local mode and enter X9. This is the end of file record. The save is now complete.

To load the saved program back into memory enter an L for the MIKBUG load routine, load the tape into the reader and place the read status switch on the cassette interface to the on position. The LOAD program will load and execute from the G entered on the saved tape. At the completion of the load the system will be in the MIKBUG monitor and by entering a G will execute your program.

If a string of question marks appears on the screen during the load, this indicates a checksum error. To recover from this, either start the load all over again or back the tape up a few inches, load the start address of the LOAD program into locations A048-A049 and enter G. Then start the tape again. If this last procedure is used, it will be necessary to reenter the start address of your program in location A048-A049 before you enter G to start your program.

Now there is no reason to shy away from those larger programs you have always wanted. So start loading the binary way and save lots of valuable time. ■

```
1000                NAM   LOAD BINARY
1010                OPT   O,S
1020                ORG   $1E00
1030    BEGIN       LDS   #$A047          move stack
1040    START       BSR   INPUT           read byte from tape
1050                CMPA  #'X             check for record mark
1060                BNE   START           no goto START
1061                BSR   INPUT           read next byte
1070                CMPA  #'1             check for data record
1080                BEQ   BL1             yes, goto BL1
1090                CMPA  #'9             check for end of file record
1100                BNE   START           no, goto START
1110                JMP   $E0E3           CONTRL all done return to monitor
1120    BL1         CLR   CHECK           clear checksum
1130                BSR   INPUT           read byte count from tape
1140                TAB                   move it to B reg
1150                BSR   INPUT           read first half of start address
1160                STAA  ADDR
1170                BSR   INPUT           read second half of start address
1180                STAA  ADDR+1
1190                LDX   ADDR            load index reg with start address
1200    BL2         BSR   INPUT           read data byte from tape
1210                STAA  X               store data byte
1220                CMPA  X               check to be sure it was restored ok
1230                BNE   BL3             no good goto BL3
1240                INX                   increment index reg
1250                DECB                  decrement byte count
1260                BNE   BL2             if not zero goto BL2
1270                BSR   INPUT           read checksum from tape
1280                INC   CHECK           increment checksum
1290                BEQ   START           if checksum good goto START
1300    BL3         JMP   $E040           LOAD19 error encountered stop processing
1310    *           subroutine to read data from tape
1320    INPUT       BSR   INE             get one byte from tape
1330                PSHA                  save A reg
1340                ADDA  CHECK           add checksum to A reg
1350                STAA  CHECK           store new checksum
1360                PULA                  restore A reg
1370                RTS
1380    *           SUBROUTINE TO REPLACE MIKBUG INEE
1390    INE         PSHB
1400                JSR   $E1A5
1410    IN1         LDAA  X
1420                BMI   IN1
1430                CLR   2,X
1440                JSR   $E1F3
1450                JSR   $E1EF           DEL
1460                LDAB  #4
1470                STAB  2,X
1480                ASLB
1490    IN2         JSR   $E1EF           DEL
1500                SEC
1510                ROL   X
1520                RORA
1530                DECB
1540                BNE   IN2
1550                JSR   $E1EF           DEL
1560                JMP   $E1E3           IOUT2
1570    CHECK       RMB   1               checksum
1580    ADDR        RMB   2               address
1590                END
```

Program 2. LOAD binary program.

Introducing HEATHKIT® COMPUTERS

A new value standard in personal computing systems featuring two powerful computers with better software, full documentation and service support from the Heath Company.

Heath Company has been interested and involved with personal computing since we first marketed an analog computer system all the way back in 1957. This continuing interest, along with the recent technological advances that have brought personal computing to the forefront of the electronics marketplace, has given us the opportunity to think through the recent developments, and develop two "total design" computer systems that give the computer hobbyist, whether beginner or advanced, everything needed for REAL power, performance and reliability — at prices that give you MORE value and performance for your computer dollar!

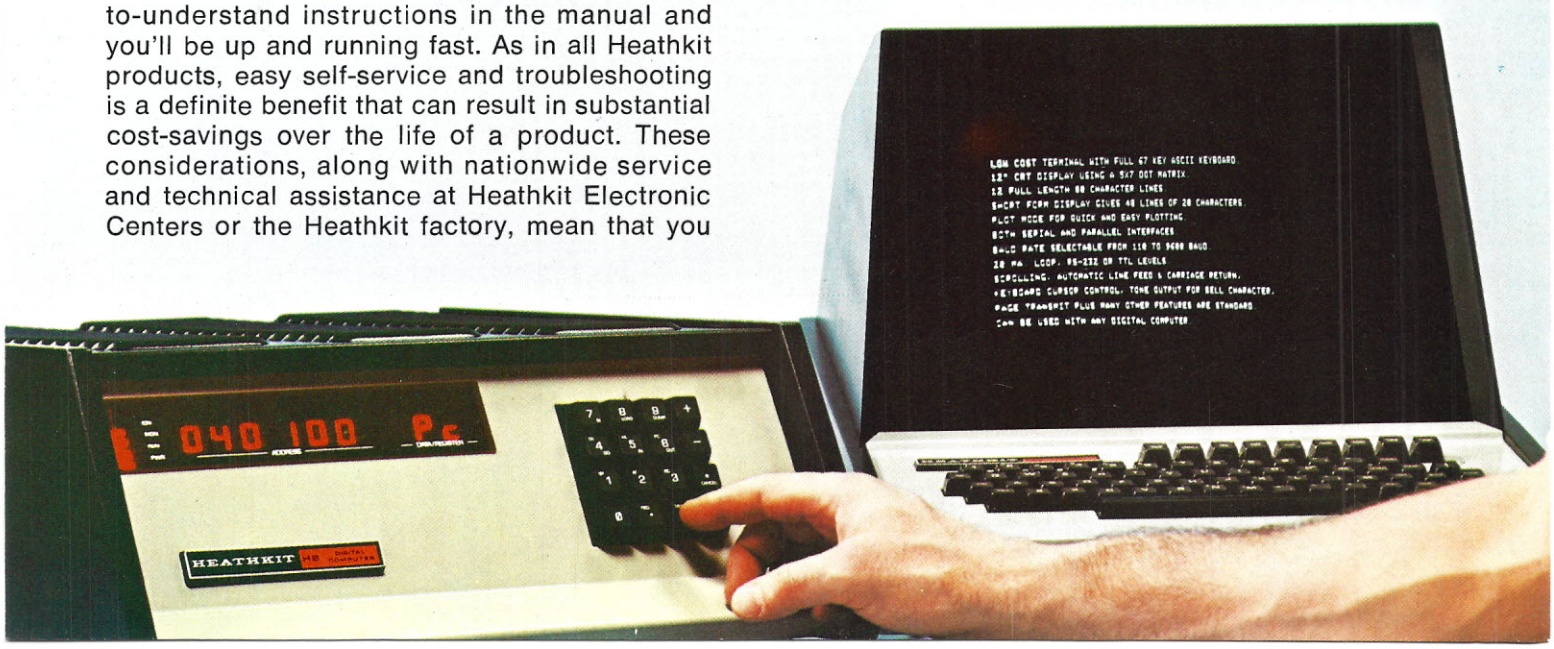
Total system design. The Heathkit computer line, both hardware and software, has been designed from the ground up to be a total computing system that meets all the needs of the computer hobbyist. The two mainframes are based on performance-proven well-documented MP modules, the 8080A and LSI-11. Using these CPU's was a conscious design decision, because of their proven performance, reliability and efficiency, and the tremendous amount of existing applications programs, documentation and source materials that are available. The Heath-designed CRT terminal, paper tape reader/punch, serial and parallel interfaces make total system setup easy and fast, and the Heath-designed software provided assures immediate usefulness and versatility.

Superior documentation. Heath Company is world-famous for the accuracy and clarity of its instruction manuals. The Heath computer line continues this well-deserved reputation. Assembly and operations manuals are written with easy-to-understand step-by-step instructions that leave nothing to chance. Simply follow the easy-to-understand instructions in the manual and you'll be up and running fast. As in all Heathkit products, easy self-service and troubleshooting is a definite benefit that can result in substantial cost-savings over the life of a product. These considerations, along with nationwide service and technical assistance at Heathkit Electronic Centers or the Heathkit factory, mean that you have the most reliable protection for your computer investment available anywhere.

System versatility. Both Heathkit computers offer full expansion potential to provide outstanding flexibility and adaptability to meet any application. Mass storage capability is available in both audio cassette and paper tape format on the H8 and in paper tape format on the H11 for added convenience. Additional memory expansion boards can be added to either unit, along with an expanding number of I/O devices.

Continuing Development. Heath will continue to design and develop new compatible products for their computer systems. Coming in the future will be — floppy disk storage, line printer, additional applications programs, and self-instructional courses in programming and assembly languages. All Heathkit computer users are eligible to join HUG (the Heath User's Group) and H11 customers are eligible to join DECUS, the Digital Equipment Computer User's Society.

We're confident you'll find the Heathkit computer line one of the most intelligent, sensibly developed and complete product lines available today. It offers you total versatility and expansion capability to go wherever your imagination and computing prowess take you. And, in the Heathkit tradition, it offers the best price/performance and reliability combination you'll find anywhere.



THE HEATHKIT H8 COMPUTER



A unique, value-packed computer featuring an "intelligent" front panel with built-in extended ROM monitor, octal entry keypad and digital readout, exclusive Heath bus, a pre-wired and tested 8080A-based CPU, and complete systems software at no extra cost!

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HEATHKIT 8-BIT DIGITAL COMPUTER

A low-cost digital computer that's easier to build and to use! Features an intelligent front panel with keyboard entry and 9-digit display, a heavy-duty power supply with enough extra capacity for memory and I/O expansion and a 50-line fully buffered bus capable of addressing 65K bytes and a mother board with positions for up to 10 plug-in circuit boards. Includes BASIC, assembler, editor and debug software at no extra cost!

The Heathkit H8 computer is an 8-bit machine based on the popular 8080A chip. It is one of the lowest-cost general-purpose computers on the market, and thanks to Heath's exclusive design, one of the most versatile.

The interrupt controlled "intelligent" front panel gives you far more power and control than is found on conventional units with bit switches and indicators. The 16-digit keyboard allows octal data entry and control that's far faster and less error prone than binary switches. The 9-digit octal readout provides you with more information than conventional models too.

The octal keyboard and display emulate a true hardware front panel with complete access to memory, all registers and functions. The 9-digit seven-segment octal display has three readout modes: 6 digits of address and 3 digits data; 6 digits register data and 2 digits register identification; and three digits data with three digits port address. The front panel functions are defined by a panel monitor control program (PAM-8) stored in a 1K x 8 ROM on the CPU board. The complete access to 8080 internal circuits and functions makes the H8 an ideal trainer and learning tool.

Complete front panel functions include: display and alter of memory locations; display and alter of registers; dynamic monitoring of registers or memory during program execution; program execution control including break-point capability and single instruction step; automatic tape load and store through a built-in routine that allows programs to be loaded with a single button; and write or read any I/O port. The front panel of the H8 is so versatile it's like having a mini I/O terminal built right in!

Other features of the H8 front panel include status lights for power-on, run, monitor and interrupt enable; a built-in speaker for audible feedback on keyboard entry. The speaker also can be programmed for variable tones, permitting a variety of special effects to be generated.

The CPU board is fully wired and tested. It features the 8080A, clock, systems controller, ROM monitor and full bus buffering. Seven vectored interrupts are available on the bus for quick response to your I/O requests. A built-in clock lets you design and run in real time.

The H8 uses an exclusive, Heath-designed bus which incorporates many practical improvements over existing busses. The bus is fully buffered to reduce noise and crosstalk and is "glitch" free to eliminate timing problems. Three-state line drivers and receivers are used on all bus lines to eliminate loading problems. The 50 lines include address, data, control, clock and interrupt lines, plus all signals needed to support the 8080 MPU and virtually any I/O or memory accessory. The bus is implemented on a heavy-duty printed circuit mother board with wide, heavy copper foils for greater physical strength plus reduced crosstalk and noise. The board has 10 positions for installing connectors that accept the front panel, CPU, memory, I/O and accessory cards. All I/O bus connectors are included with the mother board for fast and easy expansion when you want it.



Comprehensive Heathkit assembly and operations manuals give you the superior documentation you NEED for a thorough understanding of your H8.

Systems software is supplied in audio cassette format.

The H8's built-in power supply is convection cooled for adequate ventilation without the use of noisy fans. Separate IC regulators provide distributed regulation with a heat sink on each circuit board for excellent heat dissipation. Power supplies of +8, −18 and +18 volts are provided to handle up to 32k memory plus three I/O interfaces. Switch-selectable 120 V, 60 Hz or 240 V, 50 Hz AC increases versatility.

The H8 includes all system software in 1200 baud audio cassette form at no extra charge. The Benton Harbor BASIC™ is an enhanced version of standard Dartmouth BASIC with unique statements and commands to extend usefulness. The efficient compression techniques of the Benton Harbor BASIC permit you to put more program in less space.



All H8 systems software is supplied in audio cassette form. Also available in paper tape (H8-15, page 5) at extra cost.

HASL-8 The Heathkit Assembly language is a 2-pass absolute assembler that lets you program with easily understood mnemonics and generates efficient machine language code. A minimum of 8K memory is required.

The TED-8 software is a line-oriented text editor used for generating source programs for the assembler or general word processing. Requires a minimum of 8K memory.

The BUG-8 a powerful terminal console debug program, is an enhanced and extended version of the front panel monitor program to allow entry and debugging of user machine language programs via an external terminal. Requires 3K memory plus user program.

The H8 is housed in a rugged, heavy-duty cabinet, 16¼" W x 6½" H x 17" D. Requires at least one H8-1 Memory.

Kit H8, Shpg. wt. 30 lbs. **375.00**

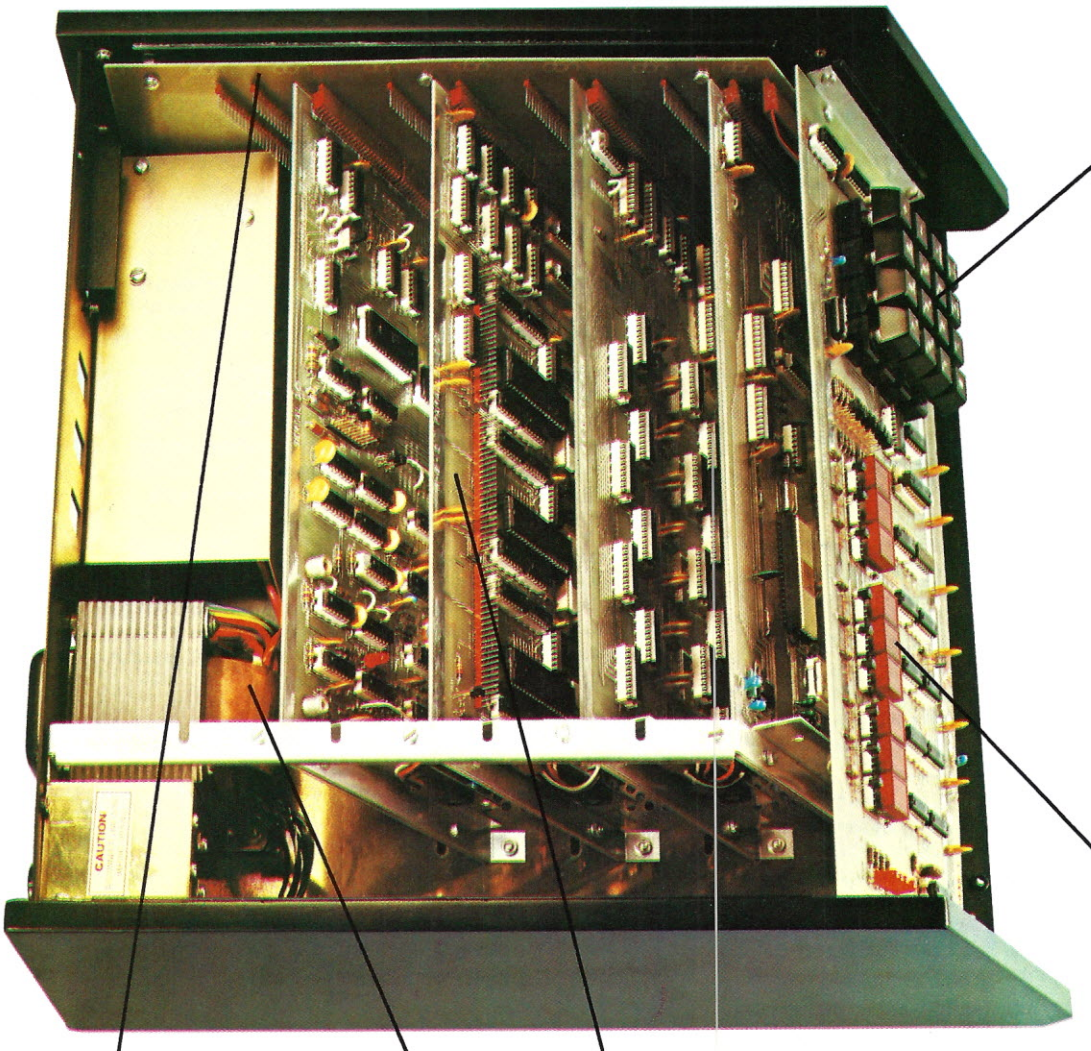
Suggested applications for the H8 computer: As a trainer—learn microprocessor operation, interfacing and programming. The powerful front panel lets you get at and use all parts of the unit.

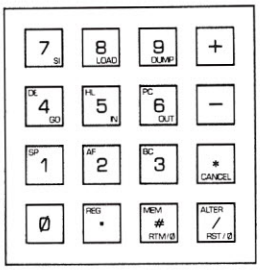
As an entertainment center—use game and other applications programs for entertainment the whole family can enjoy.

As a hobby computer—the H8 can be used to process any information you program into it—it's perfect for hobby experimentation and design. A variety of peripherals and interfaces let you use it with other equipment—run your Ham radio station, control your model railroad systems, etc.

As an educational system—the H8 is ideal for schools, community colleges, libraries, etc. Full H8 software permits teaching BASIC plus machine and assembly language programming.

As a home management center—use the H8 to keep telephone numbers, monitor your budget, keep your checkbook balanced, do your income taxes, inventory your personal belongings. There are hundreds of ways the H8 can make your life more convenient.





Its unique front panel keyboard makes the H8 the most powerful and sophisticated low-cost general-purpose computer available. Just take a look at these features!

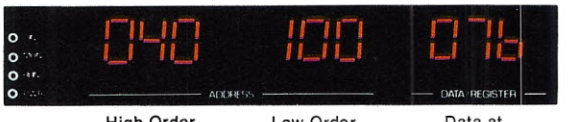
- Direct-access to registers and memory even while program is running
- One button load and dump for fast, uncomplicated system startup
- Single instruction key lets you "step" through programs for easy debugging, program evaluation and learning
- Input/output keys let you communicate directly with any port

The unique Heath-designed 50-pin bus is implemented on a heavy-duty printed circuit board with heavy copper-foil bus lines. The 10-position mother board is complete with all connectors. The bus lines are fully buffered to eliminate noise and crosstalk, and "glitch-free" to prevent timing problems.

Modular circuit boards slide into the H8 mainframe for easy memory and I/O expansion, easy access for servicing. The boards are in a semi-vertical position with unconfined heat sinks to enhance convection cooling and improve heat dissipation.

Heavy-duty power supply, rugged steel chassis and securely mounted and braced circuit boards make the H8 a truly reliable and long-life machine.

Memory Display



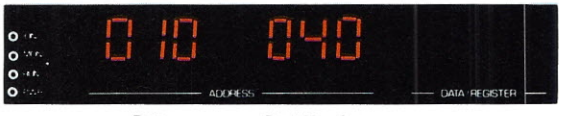
High Order Address Location | Low Order Address Location | Data at Location 040 100

Register Display



High Order Contents | Low Order Contents | Register Identification

I/O Port Display



Data | Port Number

Unique Heathkit Software.

The Heathkit software supplied with the H8 computer has a number of features that make it easier to use and more practical than conventional systems. Automatic "command completion" simplifies typing; dynamic syntax checking instantly alerts you to errors and a special user configuration lets you really personalize your system. H8 software pushes the state-of-the-art a generation ahead — it's memory efficient to give you more computing power for your memory dollar, modular design for easy expansion, and thoroughly documented for easy programming and maximum effectiveness.

H8 "Intelligent" Front Panel

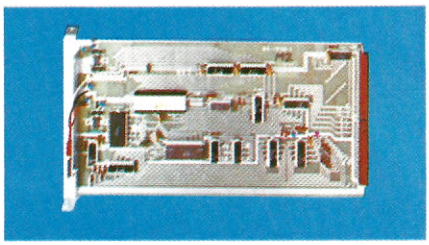
The H8 front panel digital readout is the most informative display available on any personal computer to date. All displays are continuously updated even while your program is executing, giving you instant access to registers and memory for direct monitoring of program activity.

MEMORY DISPLAY — Shows memory location and contents using 6 digits for address and 3 digits for data.

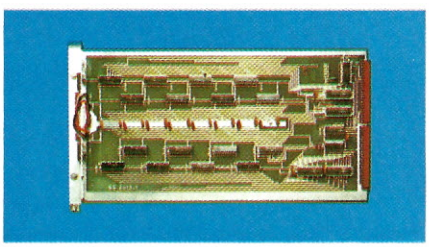
REGISTER DISPLAY — Shows CPU-register contents using 6 digits for data and 2 digits for register identification.

I/O PORT DISPLAY — Shows I/O port data and location using 3 digits for data and 3 digits for port address.

H8 ACCESSORIES, SOFTWARE AND MANUAL SET



The H8 CPU is fully wired and tested to insure quick and trouble-free system startup. It contains the performance proven 8080A microprocessor chip, a 1Kx8 ROM with monitor program for controlling the front panel and input-output (load-dump) routines. Other features of the CPU include: 7 vectored interrupts, DMA capability, crystal-controlled clock and fully buffered bus with three state drivers. Use of the 8080A, which has the largest software library of any microprocessor, along with Heath software and documentation, makes the H8 one of the most practical and immediately useful computers you can own.

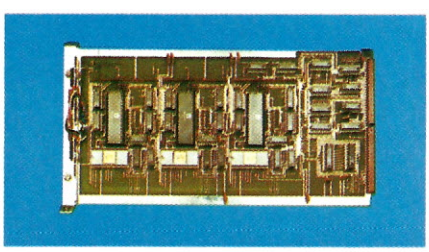


H8-1 Memory Board. 8Kx8 memory card supplied with 4K memory, plugs directly into H8 bus. Features maximum storage capacity of 8192 8-bit words. Uses modern 4Kx1 static memory IC chips for easy assembly and service. Access time, less than 450 nS. With on-board regulators, heat sinks and full buffering. Expandable to 8K memory with H8-3 chip set below.

Kit H8-1, Shpg. wt. 2 lbs. **140.00**

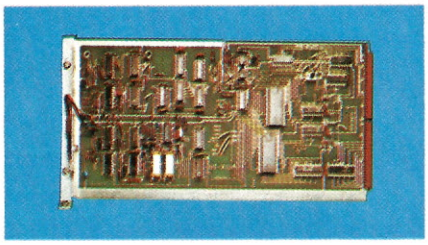
H8-3 Chip Set. Kit of eight 4K static memory IC's. Expands H8-1 to full 8K storage. With sockets.

Kit H8-3, Shpg. wt. 1 lb. **95.00**



H8-2 Parallel Interface. Connects H8 to any parallel device such as a paper tape reader/punch (required for H10) or line printer. Has three independent parallel ports, each with 8 bits input and 8 bits output and universal handshaking capability. Compatible with all Heath software. 390 μS maximum transfer time. With diode-clamped inputs, buffered outputs and full interrupt capability.

Kit H8-2, Shpg. wt. 3 lbs. **150.00**



H8-5 Serial I/O and Cassette Interface. Connects the H8 to serial devices such as the H9 video terminal (page 10) or the H36 DEC Writer II (page 12). Features jumper selectable data rate from 110 to 9600 baud, plus common input/output interfaces including 20 mA current loop and EIA RS-232C compatible levels. The cassette recorder interface permits the use of standard cassette recorders (Heathkit ECP-3801, page 12). Uses the popular Byte/Manchester or "Kansas City" standard recording format with a 300 or 1200 baud read/record rate. Control lines for remote start and stop of two cassette units allow separate record and playback for easy program or file editing. Also has full interrupt capability. LED test circuit for easy board setup and overall system servicing. Fully compatible with all Heath software.

Kit H8-5, Shpg. wt. 3 lbs. **110.00**

NOTE: Proper operation of the H8-5 is assured only if you use the Heath ECP-3801 cassette player/recorder and Heath-recommended recording tape (ECP-3802, page 12). Heath is not responsible for improper operation associated with other cassette units.

Extended Benton Harbor BASIC

Extended Benton Harbor BASIC is an enhanced and more powerful version of the BASIC supplied with the H8. It provides even faster operation and includes character strings, additional convenience commands and math functions, dynamic storage allocation, access to real time clock, keyboard interrupt processing, expanded error messages and recovery ability, LED display control and key pad support. A minimum of 12K memory is required to run this BASIC, 16K is preferred if full use is to be made of its capabilities.

H8-13 (1200 baud audio cassette)
Shpg. wt. 1 lb. **10.00**

H8-14 (fan fold paper tape)
Shpg. wt. 1 lb. **10.00**

Paper Tape Systems Software

A paper tape version of the systems software supplied with the H8 computer. It consists of four fan fold paper tapes, one each for Benton Harbor BASIC, HASL-8 assembler, TED-8 editor, and BUG-8 debug. For use with the H10 paper tape reader/punch or other paper tape I/O equipment.

H8-15, Shpg. wt. 1 lb. **20.00**

H8 Manual Set

Find out about the H8 before you buy! This manual set includes the complete assembly and operations manuals for the H8 Digital Computer, H8-1 memory card, H8-2 parallel interface, H8-3 4K memory expansion chip set, H8-5 serial and I/O cassette interface, H9 video terminal and H10 paper tape reader/punch. H8 software documentation covering monitor, editor, assembler, debug and BASIC is also included. In handsome 3-ring binder.

HM-800 Manual Set.
Shpg. wt. 11 lbs. **25.00**

The purchase price of the HM-800 manual set will be refunded when you buy the H8. Simply include HM-800 saleslip with your order.



Heath User's Group

You can get even more excitement and practical use from your H8 by joining HUG, the Heathkit User's Group. It will put you in contact with other Heathkit computer users, provide a program library and an informative newsletter to keep you up to date. A HUG application is enclosed with each Heathkit computer product. See page 12 for further details.

THE HEATHKIT

H11

DIGITAL COMPUTER

Two of the finest names in modern electronics, Heath and Digital Equipment Corporation (DEC) combine to bring you the world's first 16-bit computer priced within reach of the general public!

$1295.00



charg-a-kit

The H11 and all its accessories will be available November 10th, 1977.

HEATHKIT®/DIGITAL EQUIPMENT CORPORATION®
H11 DIGITAL COMPUTER

Heath and DEC join forces to bring you mini-computer performance at a microcomputer price! The H11 features a fully wired and tested DEC KD11F board that contains the 16-bit LSI-11 CPU, 4096 x 16 read/write MOS semiconductor memory, DMA operation; and includes the powerful PDP-11/40 instruction set, PLUS Heath/DEC PDP-11 software. Equivalent commercial versions of the H11 would cost $1,000's of dollars more!

The new Heath/DEC H11 personal computer is one of the most powerful and sophisticated units available today! It combines the advanced, performance-proven hardware and software of the LSI-11 with Heath's expertise in kit design and documentation to bring you a personal computer of almost incredible power and flexibility. Equivalent commercial versions of the H11 would cost over twice as much, and you still wouldn't get the superior documentation and support of the H11!

The LSI-11 bus is a mechanically and electrically superior bus with 38 high-speed lines containing data, address, control and synchronization lines. Sixteen lines are used for time multiplexing of data and addresses. All data and control lines are bidirectional, asynchronous, open-collector lines capable of providing a maximum parallel data transfer rate of 833K words per second under direct memory access operation.

The 16-bit CPU functions are contained on four MOS LSI integrated circuit chips. These chips provide all instructions, decoding, bus control, and ALU functions of the processor. The CPU has eight general registers which serve as accumulators, index, autoincrement/autodecrement registers or stack pointer.

The KD11F memory is a 4096-by-16 MOS semiconductor memory composed of LSI 4K dynamic RAM chips. These chips require little power, provide fast access time, and are refreshed automatically by the processor's microcode. Additional memory cards can be added to expand memory capacity up to 20K in the H11 cabinet (32K words total).

The backplane/card guide assembly holds the microcomputer and up to six I/O and memory modules. All LSI-11 bus data, control, and power connections are routed on the printed circuit backplane to each module location. The backplane/card guides are fully compatible with all standard DEC LSI-11 accessories.

An efficient, well-designed switching power supply provides the required DC voltage for the LSI-11 as well as all accessory modules. The supply features overvoltage and overcurrent/short-circuit protection, power fail/automatic restart and a built-in fan for quiet cooling. The dual primary power configuration can be connected for 115 V, 60 Hz or 230 V, 50 Hz input power.

Has single-level, vectored, automatic priority interrupt, real-time clock input signal line, ODT/ASCII console routine/bootstrap resident in microcode for automatic entry into debugging mode, replacement of panel lights and switches with any terminal device generating standard ASCII code, and the ability to automatically commence operation through resident bootstrap routines.

The H11 is supplied with versatile PDP-11 software including editor, relocatable assembler, linker, absolute loader, debug program, I/O executive program, dump routines, BASIC and FOCAL (See details below). The software requires a minimum of 8K memory, with 12K to 16K total memory recommended for maximum capability. Rugged metal cabinet measures 6½" H x 19" W x 17" D. For 110/220 VAC, 50/60 Hz.

Kit H11, Shpg. wt. 34 lbs. **1295.00**
NOTE: See DEC software license form on page 15.

POWERFUL HEATH/DEC PDP-11 SOFTWARE AT NO EXTRA COST!

The H11 includes a sophisticated software system that lets you get your computer up and running with practical programming capabilities. This paper tape based software would cost over $1200 if purchased separately. A minimum of 8K memory is required to run the software. The programs include:

ED-11. Assists you in the creation and modification of ASCII source tapes, also used to write assembly language programs and for general text editing or word processing functions.

PAL-11S. Relocatable assembler converts ASCII source tapes into relocatable binary modules. This lets you create programs in small, modular segments for easier coding and debugging. These binary modules serve as inputs to LINK-11S.

LINK-11S. Link editor which links the modules created by the PAL-11S into a load module ready for execution on the H-11. The module is loaded into the H-11 via the Absolute Loader.



The H11 is complete with superior Heathkit documentation and versatile system software.

Absolute Loader. Loads absolute binary tapes into the H11 memory for execution.

ODT-11X. Lets you debug the programs which you have created. Permits modifying and controlling program execution "on the fly" for quick, efficient debugging.

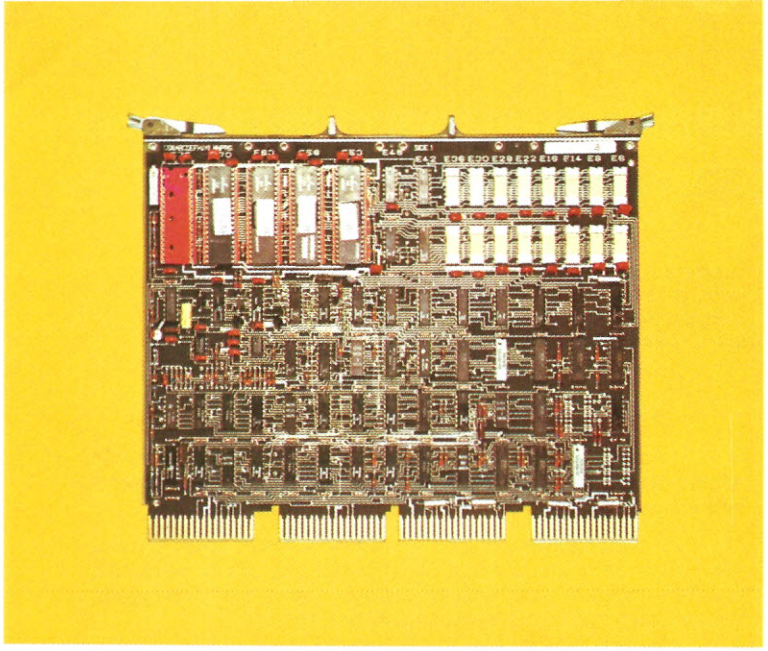
IOX. I/O executive program permits I/O programming without developing device-driving programs. Links to your programs using the LINK-11S. For use with high speed paper tape reader/punch and line printer.

DUMP-AB and DUMP-R. Lets you dump absolute binary contents of memory into the paper tape punch.

BASIC. DEC's powerful version of standard Dartmouth BASIC interpreter uses english-type statements and mathematical symbols to perform operations. Immediately translates, stores and executes the program. Includes string capability.

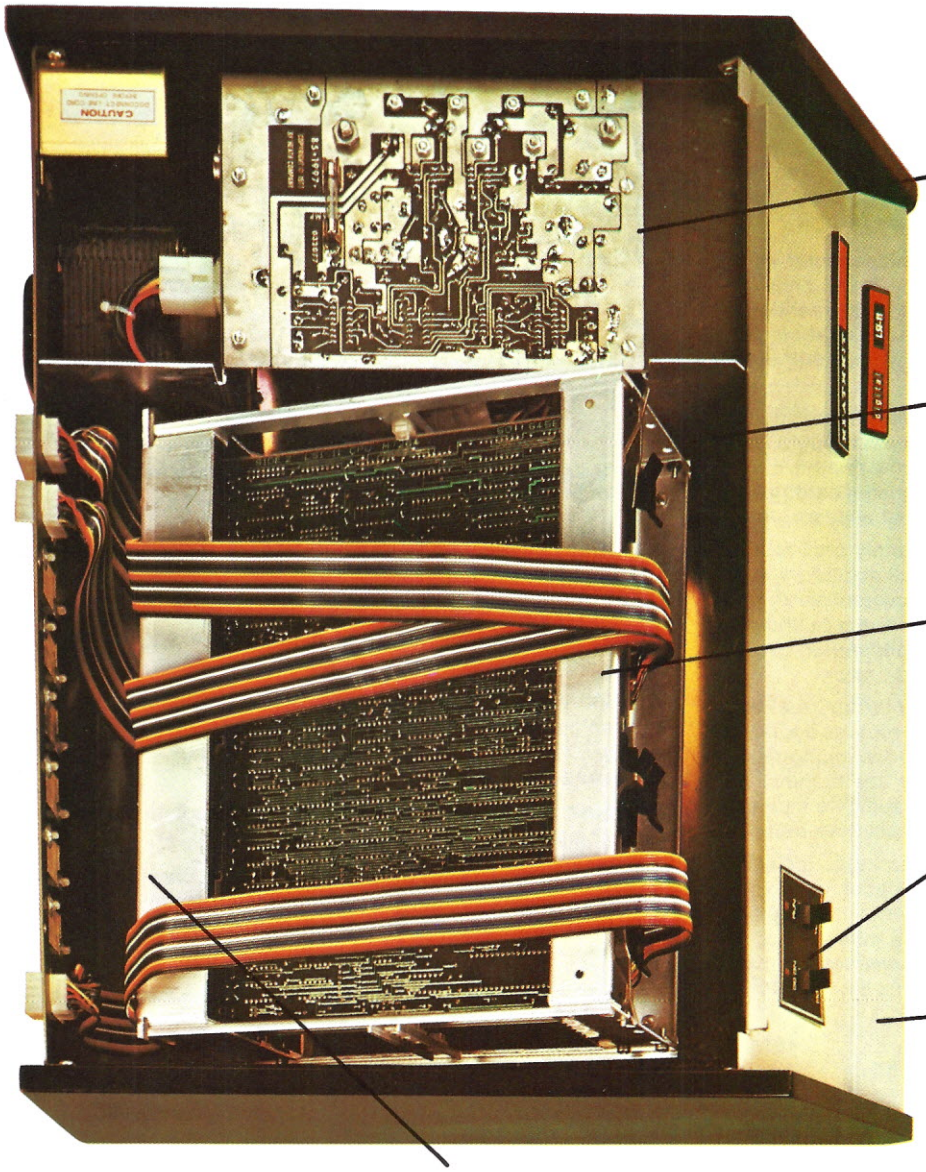
FOCAL™. DEC's own interpretive computer language which combines simplicity with computing power. Ideal for most scientific, engineering and math applications. FOCAL™ programs can be written and executed easily. Both 4K and 8K versions are included.

NOTE: H11 owners are eligible for membership in the Digital Equipment Computer User's Society (DECUS). This organization provides useful symposia, newsletters, program library and other useful information to help you get the most from your LSI-11 computer.



FULLY WIRED AND TESTED KD11F BOARD

The "heart" of the H11 computer is the standard DEC LSI-11 microcomputer board. The 16-bit CPU functions are contained in four silicon gate N-channel MOS LSI integrated circuit chips for high reliability and superior performance. The 4096-by-16 read/write MOS semiconductor memory is composed of LSI 4K dynamic RAM chips that provide fast access time and require little operating power. The CPU executes the powerful PDP-11/40 instruction set with over 400 instructions. There are no separate memory I/O or accumulator instructions, so you can manipulate data in peripheral device registers as easily and flexibly as in memory registers. The LSI-11 board is supplied fully wired and tested to facilitate kit assembly and provide greater reliability and less chance of error.



Compact, efficient switching power supply uses less power to operate and generates less heat than conventional supplies. Overvoltage and overcurrent/short circuit protection, along with automatic power-up and power-down sequencing, provide high reliability and long life operation.

Built-in quiet-running fan provides efficient cooling and prevents heat buildup.

Card cage with backplane accommodates up to six accessory cards in addition to LSI-11. The card cage swings up for easy access and service even while the H11 is operating. Accessory boards slide directly into card guides with all connectors supplied.

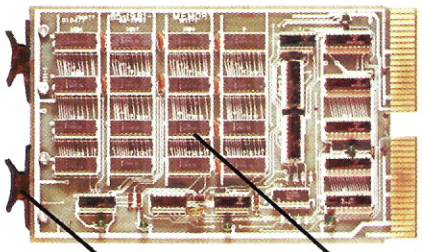
Front panel controls include DC power switch and run/halt switch. Status lights indicate processor activity.

Styled and sized to match Heathkit peripherals for total system continuity.

Rugged steel chassis and extra-thick backplane with heavy, solid connectors for added strength and years of superior performance.

The H11 and all its accessories will be available November 10th, 1977.

H11 ACCESSORIES, SOFTWARE AND MANUAL SET

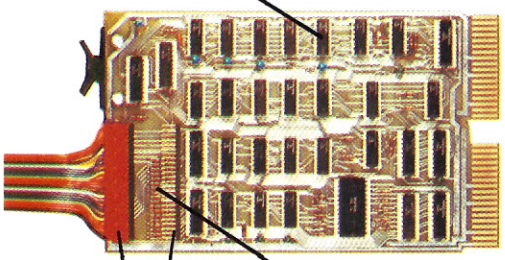


Card handles provide easy removal and insertion in card cage

Sixteen state-of-the-art 4K static memory chips for high density storage

1

All IC's are socketed for easy kit assembly, easy access for service or troubleshooting

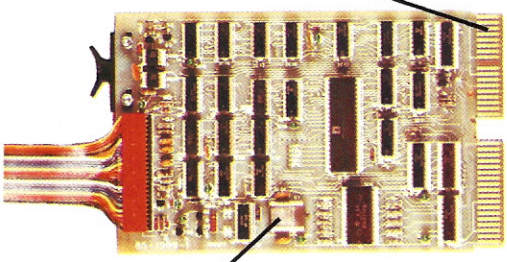


2

All inputs are diode-clamped for worry-free interfacing and system protection

Separate cables and rear panel connectors for high-byte and low-byte increase system flexibility

Gold-plated edge connectors maintain superior electrical contact for high reliability and long life



Quartz crystal and integrated baud rate generator has superior accuracy for reliable system interfacing

3

1 H11-1 4K Memory Expansion Module

Plugs into H11 backplane, adds 4K x 16-bit word capacity to H11 memory. Uses high-reliability 1Kx4 static MOS RAM chips. Access time is less than 500 nS. Has decode circuitry for operation on 4K address boundaries. Handle for easy removal and insertion. Compatible with PDP 11/03 and other LSI-11 backplane machines.

Kit H11-1, Shpg. wt. 2 lbs. **275.00**

2 H11-2 Parallel Interface

General-purpose parallel interface featuring 16 diode-clamped latched data input lines, 16 latched output lines, 16-bit word or 8-bit byte data transfers. Has LSI-11 bus interface and control logic for interrupt processing and vectored addressing; control status registers compatible with PDP-11 software routines. Four control lines for output data ready, output data accepted, input data ready and input data accepted logic operations. Maximum data transfer rate, 90K words per second under program control. Maximum drive capability, 25-ft. cable. Plugs into H11 backplane, can be used with DEC PDP-11/03 and other LSI-11 backplane machines. Also compatible with TTL or DTL logic devices. The H11-2 is required for interfacing the H11 to the H10 Paper Tape Reader/Punch.

Kit H11-2, Shpg. wt. 2 lbs. **95.00**

3 H11-5 Serial Interface

Universal asynchronous receiver/transmitter serial interface module for use between LSI-11 bus and serial devices such as the Heathkit H9 video terminal (page 10) or LA36 teleprinter (page 12). Has optically isolated 20 mA current loop and EIA interfaces; selectable baud rates of 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2400, 4800 and 9600. Plugs into H11 backplane, fully compatible with PDP 11/03 and other LSI-11 backplane machines. With all mating connectors.

Kit H11-5, Shpg. wt. 2 lbs. **95.00**

H11-6 Extended Arithmetic Chip

Adds powerful arithmetic instructions to the LSI-11, including fixed point multiply, divide and extended shifts plus full floating point add, subtract, multiply and divide. Helps minimize or eliminate arithmetic sub-routines, speeds up program execution and eases program development. Saves memory space too. 40-pin dual-inline package IC plugs into socket on KD11F board.

H11-6, Shpg. wt. 1 lb. **159.00**

Manual Set for H11 Computer

Includes complete assembly and operation manuals for the H11 Digital Computer, H11-1 4K memory board, H11-2 parallel interface, H11-5 serial interface, H9 CRT terminal, and H10 paper tape reader/punch. Also includes complete software documentation — monitor, editor, assembler, linker, BASIC, FOCAL and related software. In handsome 3-ring binder.



HM-1100 Manual Set,
Shpg. wt. 12 lbs. **25.00**

NOTE: The price of the manual set can be deducted when you order an H11.

NOTE: DEC, DIGITAL, FOCAL and PDP are registered trademarks of Digital Equipment Corporation.

Special DEC Software License Requirement

H11 purchasers are required to fill out and sign the DEC license agreement on page 15. Please do so and include with your H11 order. Heath cannot ship merchandise without this license agreement.

THE HEATHKIT H9 VIDEO TERMINAL

One of the lowest-cost full ASCII terminals available anywhere — features a bright 12″ CRT display with twelve 80-character lines, 67-key keyboard, all standard serial interfaces, plus a fully wired and tested control board and a wiring harness for simplified assembly.

$530.00

heath charg-a-kit



H9 LONG AND SHORT-FORM VIDEO DISPLAY TERMINAL

The H9 video terminal is a general-purpose computer peripheral designed for use with the Heathkit H8 or H11 computers. It provides keyboard input and a CRT for the convenient entry and display of computer programs and data. The H9 can be used with any digital computer in dedicated stand-alone applications or in time-sharing systems.

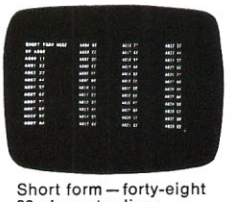
Character format is standard upper case 5 x 7 dot matrix. The long form display is twelve 80-character lines. The short form display is forty-eight 20-character lines in four 12-line columns. The automatic line carryover feature executes line feed and return when line exceeds character count on both long and short form displays. A built-in oscillator/speaker generates a 4800 Hz tone and serves as audible end-of-line warning.

Auto-scrolling is featured in both long and short form. In the long form, as the line enters at bottom, the top line scrolls off-screen; in the short form, as new column enters from right, the left column scrolls off-screen. Auto-scrolling can be defeated with a front panel switch. The cursor mark indicates the next character to be typed for accurate positioning. Cursor control keys include up, down, left, right and home. Serial data baud rates are selectable from 110-9600. Baud rate clock output and reader control are available on the rear panel connector. The erase mode permits automatic full page erase or erase to end of line starting at cursor position. A transmit page function allows a full page to be formatted, edited and modified, then transmitted as a block of continuous data.

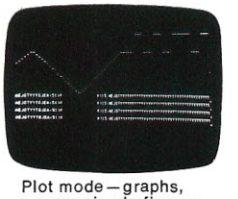
The plot mode permits graphs, curves and simple figures to be displayed. Plotting can be accomplished via the keyboard or from external inputs.



Long form — twelve 80-character lines

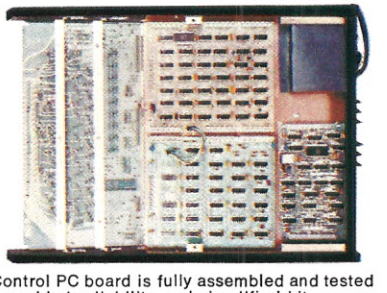


Short form — forty-eight 20-character lines



Plot mode — graphs, curves, simple figures

Three separate modes give the H9 real display versatility



Control PC board is fully assembled and tested for added reliability and simplified kit assembly. A wiring harness with connectors helps reduce time-consuming point-to-point wiring.

The H9 serial interface provides EIA RS-232C levels, a 20 mA current loop or standard TTL levels. Parallel interfacing includes standard TTL levels, 8 bits input and 8 bits output and 4 handshaking lines.

Ultra-compact size, only 12½″ H x 15⅝″ W x 20¾″ D, makes the H9 ideal for desktop or console applications. For 110 VAC, 60 Hz or 230 VAC, 50 Hz.

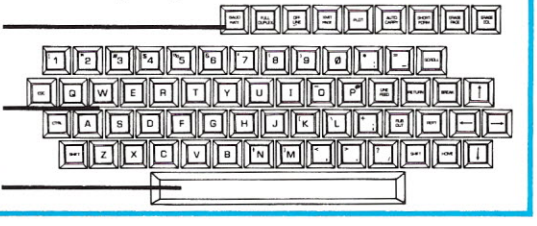
Kit H9, Shpg. wt. 50 lbs. **530.00**

Full ASCII 67-key Keyboard

Function keys are positioned away from characters to prevent miskeying and error.

Standard typewriter keyboard for easy, more accurate input.

Wide, easy-to-use space bar aids accurate typing.



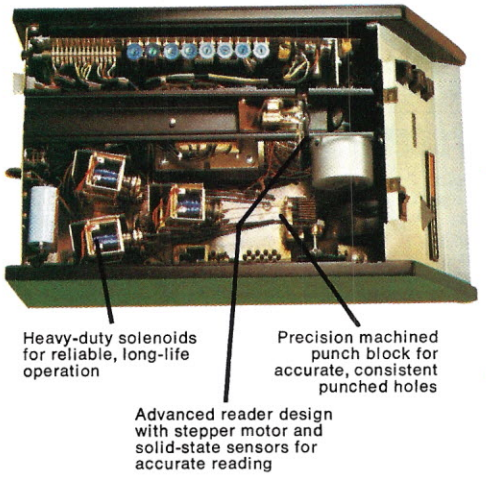


THE HEATHKIT H10 PAPER TAPE READER/PUNCH

A general-purpose mass storage peripheral designed for use with the H8 and H11 computers plus any other computer. Features a heavy-duty built-in power supply, totally independent punch and reader and a copy mode for fast, easy tape duplication.

$350.00

H10 DELUXE PAPER TAPE READER/PUNCH



The H10 is a complete paper tape reader/punch mass storage peripheral using reliable low-cost paper tape. It's fully compatible and styled to match with the H8 and H11 computers. It also works reliably with any other computer through a parallel interface. The H10 uses standard 1" wide roll or fan-fold 8-level paper tape. Standard punched paper tape gives you the reliability, durability and trouble-free handling you need for effective mass storage of programs and data.

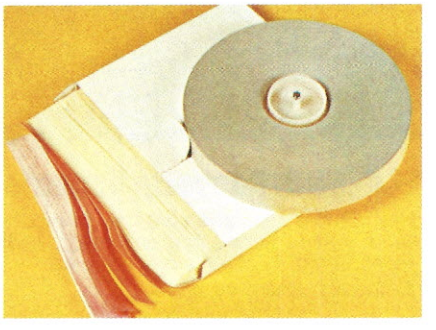
The reader reads tape at a maximum rate of 50 characters per second. A full sensitivity adjustment on each channel permits any color, thickness, quality (oiled or unoiled) paper tape to be used. Sensitive photo Darlington transistors and an incandescent lamp reader head provide reliable reading. The powerful stepper motor drive insures accurate tape positioning and movement.

The punch operates at a maximum speed of 10 characters per second. Precise ratchet/solenoid drive and reliable solenoid control of punches provide high-accuracy punching. The precision die-block punch head gives you positive and consistent punching.

Controls include power on-off, read and punch start. A feed control feeds blank paper tape through the punch to produce leader tape. A copy control on the rear panel permits tape being read to be duplicated by the punch for efficient and accurate tape copying.

Interface has parallel 8-bit input bus for punch, parallel 8-bit output bus for reader, standard TTL logic levels and handshaking lines for both reader and punch. A rear panel 24-pin interface connector and mating cable are supplied. The H10 is fully compatible with Heathkit H8 and H11 computers when the appropriate parallel interface accessories are used. It can also be interfaced with other computers with parallel interface facility.

Accessories include holder for roll paper tape, chad collector tray, and collector box for fan-fold tape. With 8" roll (900 ft.) blank paper tape.



Styled to match the Heathkit H8 and H11 computers. Cabinet with metal top and rugged steel chassis, 12⅝" H x 9¾" W x 19⅝" D. For 110-130 VAC, 60 Hz, or 220-240 VAC, 50 Hz.

Kit H10, Shpg. wt. 29 lbs. **350.00**

H10-2, Three Blank Rolls Paper Tape, each 8" diameter, 900 ft. min.

H10-2, Shpg. wt. 5 lbs. **10.00**

H 10-3, Three Boxes Blank Fan-fold Tape. Approx. 1000 ft. each.

H10-3, Shpg. wt. 5 lbs. **10.00**





ECP-3801 Cassette Recorder Storage Device

Has volume and tone controls, pushbuttons for record, play, rewind, fast forward, stop and eject, built-in 3-digit counter with reset button. Factory wired, not a kit.

ECP-3801, Shpg. wt. 6 lbs. **55.00***

Heath recommended high output, low noise, premium grade audio recording tape. Pack of three 30-minute blank cassettes.

ECP-3802, Shpg. wt. 1 lb. . . . . **per pack 5.00**

*NOTE: Proper operation of the H8-5 and H8 software is assured only when the ECP-3801 cassette recorder and ECP-3802 tape is used. Heath does not assume responsibility for improper operation resulting from the use of any other cassette units.

HUG®–the Heathkit User's Group

Our new user's group brings you in contact with other Heathkit computer owners and users, provides a newsletter, a program library, new product information and hardware/software ideas. Membership in HUG is a useful, practical way to get the maximum enjoyment and benefit from your Heathkit computer system. Here's what you get:

- 1 year subscription to the quarterly newsletter
- Software library allowing you to submit programs and obtain programs submitted by others. A modest fee will be charged for software duplication.
- An attractive 3-ring binder to hold newsletters, software documentation and other materials.
- Program submission forms • Software library catalog
- HUG membership list • Credit toward purchase of software

Dues are $14.00 for one year. Complete details of HUG membership are included with every Heathkit computer product. H11 owners are also eligible for membership in DECUS, see page 7 for details.

LA36 DEC Writer II Keyboard Printer Terminal

The famous LA36 DEC Writer II with true 30-cps throughput, variable-width forms handling, 128-character upper/lower case set, and extra-quiet operation. Fully assembled, factory tested and ready to use!

The LA36 is an advanced technology teleprinter offering fast, reliable operation at one of the best price/performance ratios in the industry. It features a 7x7 dot matrix print head for crisp, clear character formation; switch-selectable 10, 15 and 30 cps printing speeds; variable width forms handling from 3 to 14⅞" wide; adjustable right and left hand tractors for precise margin positioning; half or full duplex operation; ANSI-standard multikey rollover and a typewriter-like keyboard.

The precision-designed stepper motor paper feed has fine vertical adjustment for accurate forms placement. LA36 will handle up to 6-part forms with a .020" maximum pack thickness. Print format is 132-column, with 10 characters per inch horizontal spacing and 6 lines per inch vertical spacing. Uses the entire 128 character ASCII upper/lower case set with 95 printable characters. A CAPS-lock key simplifies data entry. A parity check on output prints a replacement character, strappable to odd, even, or none with mark or space. A last-character visibility feature moves the head four columns to the right when printing stops, returns to proper position when printing is resumed.

The integral 20 mA current loop interface makes the LA36 compatible with both the H8 and H11 computers, as well as all other hobby and personal computers. Operates on 90-132 VAC or 180-264 VAC for reliable performance even under brown-out conditions. With connecting cable and integral stand for easy setup. Overall size, 27½" W x 33¼" H x 24" D.

H36 (LA36 DEC Writer II) Shipped Motor Freight, prepaid to your nearest terminal within the Continental U.S. Include your phone number on order for notification of arrival. Arrangements for home delivery at extra charge at your option. NO C.O.D ORDERS ACCEPTED. **$1495.00**

H36-1 Fan-fold paper for H36. Standard 14⅞" x 11" white and green, single part, tined paper. 3450 sheets per carton.

H36-1, Shpg. wt. 50 lbs. **30.00**

H36-2 EIA Interface. Provides EIA RS232-C or CCITT-V24 interface for LA36. Includes auto answer, timed disconnect and half/full duplex logic. Straps are available to send timed break (230 mS), 3000 mS long space, forced disconnect or do nothing (stops printing, discards data) on a paper-out condition. Modem controls and a 9-ft. cable with 25-pin data-set type connector are also supplied. Factory wired, not a kit.

H36-2. Shpg. wt. 1 lb. **65.00**

APPLICATIONS SOFTWARE–COMING SOON!

Both the H8 and H11 Digital Computers are supplied with complete systems software that provide you with everything you need to develop your own specific applications programs. However, you can make your computer immediately useful by using the programs below. These programs represent the beginning of a complete series of application software packages that will allow you to get immediate value from your computer system without a time consuming software development effort on your part. Described below are a series of game packages that make your computer an excellent source of entertainment and leisure time activities.

BLACKJACK. An interactive program game that allows four players to play the card game blackjack on the computer. The computer performs all of the functions of the dealer and keeps track of player progress, winnings and losses. The program is written in and runs under extended BASIC and requires a minimum of 16K of RAM in the H8 and 8K in the H11. Standard Las Vegas casino blackjack rules apply.

BIORHYTHM. This popular applications program computes standard biorhythm information and plots sinusoidal curves of your physical, emotional, and intellectual characteristics over a given time period. The biorhythm program will show you your ups and downs and will tell you your good and bad days. It will help you plan your activities. While this program is not a game, it is an entertaining activity that you and your friends and family will enjoy. The program runs under extended BASIC and requires 16K of RAM in the H8 and 12K RAM in the H11.

STARTREK. Startrek is perhaps the most popular computer game available. It allows you to guide, control and command the Starship Enterprise in its travels through the galaxy, fighting Klingons and solving a variety of problems. A truly challenging, sophisticated and entertaining computer game. Runs on the H8 or H11 computers with 8K of RAM or more.

GAME SET #1. This software package lets you play 8 popular computer games. These games include Craps, Orbit, Tic Tac Toe, Nim, Hexapawn, Hangman, Hmrabi, and Derby. 8K RAM or more is required on either the H8 or H11. These games will provide hours of entertainment for you and your family.

GAME SET #2. Another popular game package for the H8 and H11 computers. Contains 8 popular computer games including bagles, slot machine, gomoko, yahtze, apollo, gunner, wumpus, and cube.

AVAILABILITY. Blackjack, Biorhythm and Startrek will be available after October, 1977. Game Set #1 will be available November, 1977 and Game Set #2 available, February, 1978.

Order a complete Heathkit computer system and SAVE!



The ECP-3801 is the Heath-recommended cassette recorder/player for use with the H8 computer software. See opposite page for complete description.

SYSTEM ONE

The minimum recommended H8 system

H8 Computer	$375
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H9 Video Terminal	530
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H9 Video Terminal	530
ECP-3801 Cassette Recorder/Player	55

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SYSTEM THREE

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H11-5 Serial Interface	95
H9 Video Terminal	530
H10 Paper Tape Reader/Punch	350

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H11/LSI-11/PDP-11 BOOKS

Here are several important reference sources to help you get the most value from your H11 Computer.

Minicomputer Systems: Organization and Programming (Prentice-Hall). Good basic text. Emphasis on the PDP-11. **EDP-238** **17.95**

PDP-11 Programming (Algonquin). A programmed instruction text teaching the concepts of PDP-11 operation and programming. **EDP-239** **5.00**

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Decoding Device Control Codes

. . . uses a UART, naturally

If you are using the SWTPC AC-30 cassette interface with a terminal that does not provide decoding of the device control codes (ASCII DC1, DC2, DC3, DC4), you must either start and stop tape units manually or connect the control lines directly to the MP-C PIA and provide special software to decode device control codes. Initially I had connected to the MP-C PIA, as the editor and assembler provided this software. The current versions of 4K and 8K BASIC do not provide these control routines, but assume instead that your equipment will decode the device controls.

Rather than modifying 8K BASIC or digging into the guts of my terminal to find device controls I decided to build a circuit to perform the decode function within the AC-30. This circuit uses a UART to convert the serial data from the MP-C control interface into parallel data and then two BCD-to-Decimal decoders to decode the desired control codes from the parallel data output of the UART (see Fig. 1).

Table 1 shows the device control codes, their values and uses. Note that these codes are normally associated with control of the paper tape reader and punch on a teletypewriter, however we are performing an equivalent job in control of cassette recorders.

The entire circuit can be built on a 2½ inch square circuit board and mounted inside the case of the AC-30. All but three of the external connections can be made through the AC-30 Control Connector (J4). These remaining connections can be soldered to the foil on the AC-30 circuit board.

Before installing the control decoder in the AC-30 check the voltage on the -13 volt line. (In my AC-30 it was 11.5 volts.) As the maximum voltage from the +5 to -12 volt input of the AY-5-1013 is defined as 20 volts, anything up to about -14 should be OK. I expect that the UART will operate properly with a Vgg supply anywhere in the range of -10 to -14 volts. One other note; make sure you jumper Control Invert (J4-pin 8) to ground (J4-pin 2). The output of the control decoder is a positive pulse and this jumper sets up the AC-30 to expect this pulse.

Once installed, the MIKBUG L and P commands can be used to verify that the decoder is working properly. The following sequence will perform those tests.

1. Set memory locations A002 through A005 to 00 00 00 10.
2. Set both the record and read status switches on the AC-30 to their center position.
3. Enter a P on the control console. The record ready light should come on, one line of MIKBUG format dump should be displayed and then the record ready light should go out.
4. Enter an L on the control console. The read ready light should come on.
5. Enter an S9 on the control console. The read ready light should go out.

If none of the functions work it is probably an error connecting up the UART. If a particular function does not work Table 1 should help in locating the error. ■

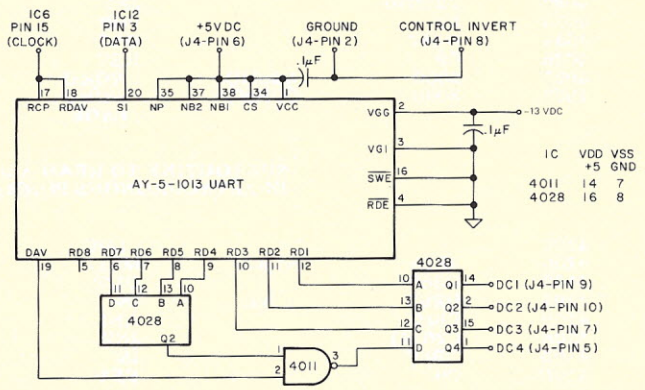


Fig. 1. Schematic of Device Control Decoder.

ASCII Code	Hexadecimal Value	Use	J4 Pin Number
DC1	11	Reader (Play) on	10
DC2	12	Punch (Record) on	9
DC3	13	Reader (Play) off	7
DC4	14	Punch (Record) off	5

Table 1. Device Control Codes.

Tarbell Asynchronous Format

. . . when you need a byte at a time!

```
                        .TITLE      /ASYNCHRONOUS TARBELL CASSETTE ROUTINES/
                        ;
                        ;
                        ;SUBROUTINE TO WRITE A BYTE TO CASSETTE
                        ;DATA IS EXPECTED IN REGISTER A
                        ;
                        ;
                                    .PABS                   ;ABSOLUTE ADDRESSES
                                    .LADDR                  ;LIST WITH LO BYTE FIRST
                        ;
4000                                .LOC        4000H       ;LET'S START HERE
4000    4F          ACW:    MOV     C,A         ;SAVE THE DATA
4001    1610                MVI     D,10H       ;OUTER MODULO
4003    3E3C                MVI     A,3CH       ;START BYTE
4005    CD2B40              CALL    COUT        ;OUTPUT START BYTE
4008    3EE6                MVI     A,0E6H      ;SYNC BYTE
400A    CD2B40              CALL    COUT        ;OUTPUT SYNC BYTE
400D    79                  MOV     A,C         ;DATA BACK IN REGISTER A
400E    CD2B40              CALL    COUT        ;OUTPUT DATA
4011    FE20        . . A1: CPI     ' '         ;LOOK FOR CONTROL CHR
4013    DA1940              JC      . . A2      ;JUMP IF CONTROL CHR
4016    2A3740              LHLD    ASCMD       ;LOAD MODULO FOR ASCII
4019    D21F40      . . A2: JNC     . . A3      ;JUMP IF NOT CONTROL CHR
401C    2A3940              LHLD    CONMD       ;LOAD MODULO FOR CONTROL
401F    7C          . . A3: MOV     A,H         ;REG H TO A
4020    B5                  ORA     L           ;LOOK FOR ZERO
4021    2B                  DCX     H           ;DECREMENT INNER COUNTER
4022    C21F40              JNZ     . . A3      ;LOOP IF NOT ZERO
4025    15                  DCR     D           ;DECREMENT OUTER COUNTER
4026    79                  MOV     A,C         ;DATA BACK IN REGISTER A
4027    C21140              JNZ     . . A1      ;LOOP IF NOT ZERO
402A    C9                  RET                 ;DONE
402B    F5          COUT:   PUSH    PSW         ;SAVE THE DATA
402C    DB6E        . . C1: IN      6EH         ;GET STATUS OF TARBELL BOARD
402E    E620                ANI     20H         ;LOOK AT BIT 5
4030    C22C40              JNZ     . . C1      ;LOOP IF NOT READY
4033    F1                  POP     PSW         ;DATA BACK IN REGISTER A
4034    D36F                OUT     6FH         ;OUTPUT THE DATA
4036    C9                  RET                 ;DONE
4037    2000        ASCMD:  .WORD   0020H       ;COUNTER MODULO FOR ASCII CHRS
4039    3000        CONMD:  .WORD   0030H       ;COUNTER MODULO FOR CONTROL CHRS
                            .PAGE
                        ;
                        ;
                        ;SUBROUTINE TO READ A BYTE FROM CASSETTE
                        ;IN ASYNCHRONOUS FORMAT
                        ;
                        ;
4100                                .LOC        4100H       ;START
4100    3E10        ACR:    MVI     A,10H       ;RESET TARBELL BOARD
4102    D36E                OUT     6EH
4104    DB6E        . . A1: IN      6EH         ;INPUT STATUS OF TARBELL BOARD
4106    E610                ANI     10H         ;LOOK AT BIT 4
4108    C20441              JNZ     . . A1      ;LOOP IF NOT READY
410B    DB6F                IN      6FH         ;GET DATA FROM THE TARBELL BOARD
410D    C9                  RET                 ;DONE
                        ;
                        ;
                        ;ROUTINE TO READ FROM CASSETTE INTO MEMORY
                        ;
                        ;
4200                                .LOC        4200H       ;START
4200    211000      CMR:    LXI     H,0010H     ;STARTING MEMORY ADDRESS
4203    CD0041      . . C1: CALL    ACR         ;GET A BYTE FROM CASSETTE
4206    77                  MOV     M,A         ;DATA INTO MEMORY
4207    23                  INX     H           ;INCREMENT HL
4208    C30342              JMP     . . C1      ;LOOP BACK
                            .END
```

Fig. 1. TDL Z-80 Relocating Version 1.1, Asynchronous Tarbell Cassette Routines.

Jim Gordon
Box 38113
Los Angeles CA 90038

What if you had a piece of software which required you to output data to a paper tape punch (or some other asynchronous device) one byte at a time? Not too many of us have paper tape punches . . . including Jim Gordon. Therefore, he came up with a technique for using his Tarbell Cassette Interface to fool that software (TDL Z-80 Assembler) into thinking it was sending data out to a punch.

(Incidentally, the single byte program was written using the Z-80 assembler but all the code is 8080.) — John.

Here's a new way to use your Tarbell Cassette Interface. In normal operation the interface is used to write a block of memory to cassette, or to read a block from cassette into memory. But what if you want to write one byte at a time, with any amount of time in between bytes, the way a paper tape punch does? This format will do that, and you can set the time between bytes to your own choosing.

It works like this: When it's time to write a byte, we send the Tarbell board a start byte, a sync byte, the data byte, and then pause a fraction of a second in a timing loop before going further. (Without the pause, the interface board won't write to tape correctly). Then the board is ready for the next sequence; start byte, sync byte, data byte, pause, etc. Any amount of time can pass after the pause, because we're always starting a new sequence. I've found it handy to have two different length pauses; a short one following an ASCII character, and a slightly longer one following a control character. Two words are set up as a reference to control the length of the pauses. On my system the minimum to set each word is about 0020 hex.

By making the pause longer we can set it up so that a program that requires time between bytes may have it. (A program that needs time between bytes to search through a symbol table, for instance).

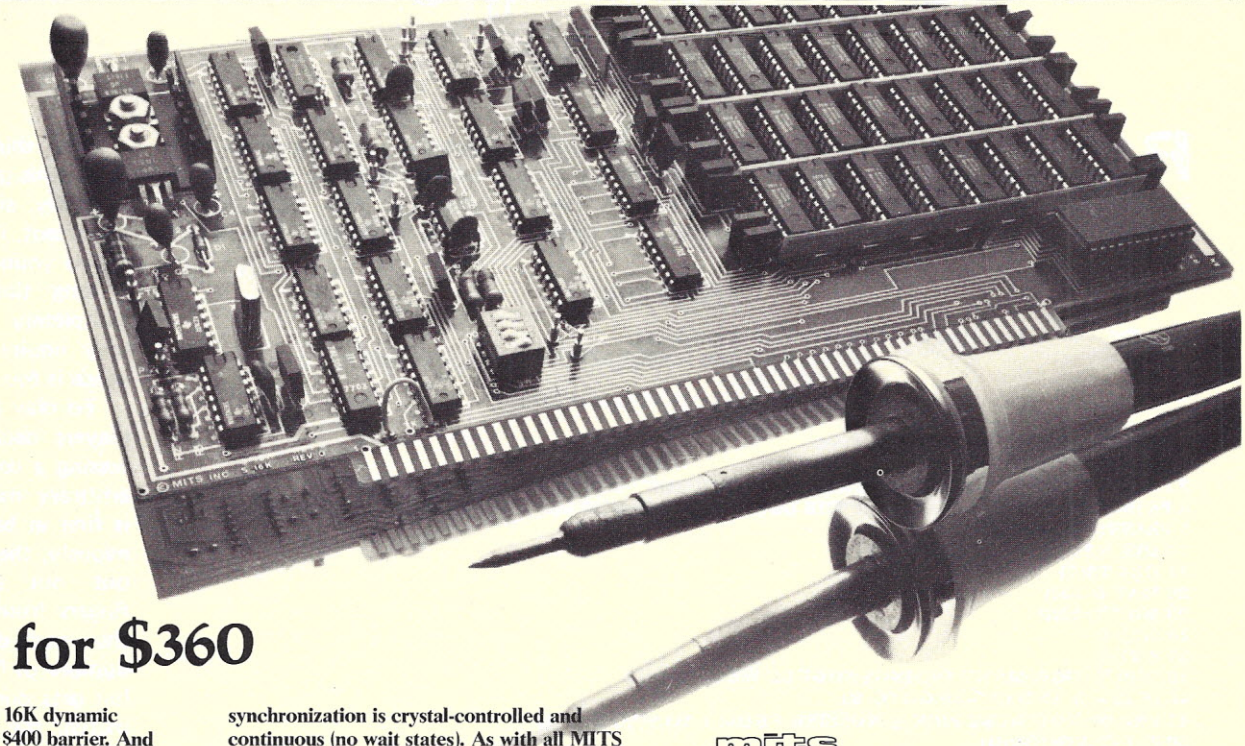
When reading a byte with this format, we send the board a 6E to reset it, loop until ready, input the data byte, send out another 6E, loop, input a byte, send out another 6E, etc.

I'm using this with my TDL Z-80 assembler, which requires both a punch and reader that it can step one byte at a time. First I make the source listing with an editor and put it on cassette with the asynchronous format. Then I put it all into memory and use memory as a controlled reader. As the assembler makes its second and third passes, it makes a listing and then outputs object code. The cassette machine is again the punch, using the asynchronous format. Faster than paper tape, and cheaper than a floppy!

Notice that the routine to write into memory from the cassette is not a subroutine. It starts loading into memory at the starting address in H+L, and keeps on going until you stop it. ■

ACR	4100	ACW	4000	ASCMD	4037	CMR	4200
CONMD	4039	COUT	402B				

Fig. 2. Symbol Table.



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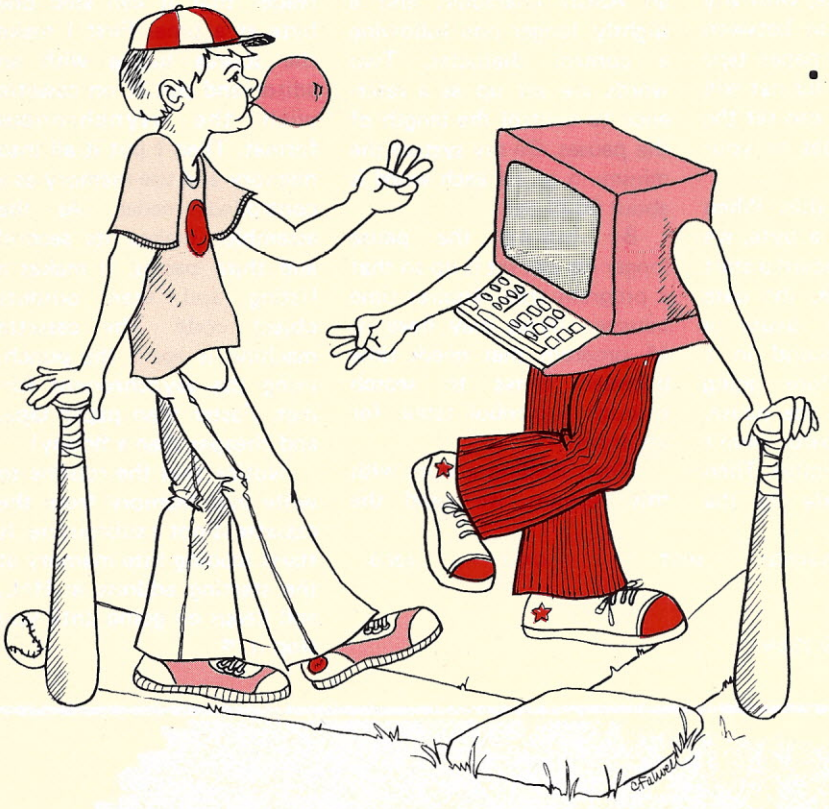
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Irwin Doliner
PO Box 290
Owings Mills MD 21117

Baseball in BASIC

... new twist for an old game



Recently a friend of mine was playing a game with a young boy. It was a game which he invented years earlier to amuse his young son. He invented it at a time when computers were thought to do little besides messing up accounts and sending dunning letters. This game, as the title of the article indicates, is baseball.

Program listing.

```
0 REM        PROGRAM:    COMPUTER BASEBALL
                         IRWIN DOLINER (INTERACTIVE DATA SYSTEMS)
                         P.O. BOX 290
                         OWINGS MILLS, MARYLAND 21117

1 INPUT"WHAT IS YOUR NAME";N$
2 N$=N$+"S":PRINT:PRINT:PRINT:PRINT
3 PRINT"THIS IS A BASEBALL GAME BETWEEN THE ";N$;" AND THE HEXADECS."
4 PRINT"WE ARE PLAYING FOR THE COMPUTER LEAGUE PENNANT SO PLAY YOUR BEST."
5 PRINT:PRINT:PRINT
10 DIM I(2,9),B$(5),T(5),S(2),B(5)
11 DIM T$(2)
20 MAT I=ZER
23 MAT T=ZER
26 S(1)=0
27 S(2)=0
30 INPUT"HOW MANY INNINGS SHOULD WE PLAY";I2
40 IF I2 >0 AND I2 <10 GOTO 50
45 PRINT"YOU MUST PICK A NUMBER FROM 1 TO 9":GOTO 30
50 F=INT(2*RND(3))
60 IF F=1 GOTO 90
70 PRINT "I'M THE VISITING TEAM"
71 T$(1)="** HEXADECS ARE UP **"
72 T$(2)="** "+N$+" ARE UP **"
80 GOTO 100
90 PRINT "YOU'RE THE VISITING TEAM"
91 T$(1)="** "+N$+" ARE UP **"
92 T$(2)="** HEXADECS ARE UP **"
100 PRINT "DO YOU NEED INSTRUCTIONS";
110 INPUT Y$
```

Two things intrigued me about this game. First, it was elegantly simple, but more important, it held the interest of the young player for quite a long time. The game is completely portable — the only equipment each player needs is four fingers.

To play the game the two players decide by choosing, tossing a coin or some other arbitrary means, which team is first at bat. Then, simultaneously, the two players each put out any number of fingers from zero to four. If they each display a different number of fingers the team at bat gets one out. But if they match, the team at bat gets the following:

No.	Team Gets
0	walk
1	single
2	double
3	triple
4	home run

Each player must then keep track of his base runners and how many runs he has scored.

Not being one to leave well enough alone, I have written a program which plays baseball according to the above rules. Of course I had to dispense with the fingers, since the computer hasn't any, and instead simulate them with random numbers. In addition to comments (attempts at humor) and aesthetic printing formats, one basic change was made in the number generation. The numbers zero through four are generated according to varying frequencies in an attempt at realism. The probabilities of generating the different numbers are as follows:

No.	Probability
0	.05
1	.50
2	.30
3	.10
4	.05

The game is simple to play, and a quick perusal of the sample run should give you an idea of what to expect. If instructions are required the program will produce them for you (lines 121-135).

As you play the game you will probably want to add some of your own refinements. Two changes which could be made come immediately to mind. Perhaps you would like to consider them. If the score is tied at the end of the specified number of innings, the program calls this a tie game. The program could be changed to play extra innings until there is a winner. Presently the bottom half of the last inning is played even if the home team is winning. This too could be changed to reflect what occurs in a real game.

Whether you change and personalize the game, or play it in its present form, I hope that you have fun with it. ■

```
115 IF Y$="N" GOTO 160
120 IF Y$="NO" GOTO 160
121 PRINT "WE EACH PICK A NUMBER FROM 0 TO 4. IF OUR NUMBERS MATCH"
122 PRINT "THEN WHOEVER IS AT BAT GETS WHAT THE NUMBER INDICATES, AS"
123 PRINT "FOLLOWS:"
124 PRINT
125 PRINT "NUMBER          RESULT"
126 PRINT "******          ******"
127 PRINT " 0              WALK"
128 PRINT " 1              SINGLE"
129 PRINT " 2              DOUBLE"
130 PRINT " 3              TRIPLE"
131 PRINT " 4              HOME RUN"
132 PRINT
133 PRINT "IF OUR NUMBERS DO NOT MATCH THEN THE TEAM AT BAT GETS"
134 PRINT "AN OUT — NATURALLY 3 OUTS RETIRE THE SIDE."
135 PRINT "OKAY? LET'S PLAY BALL"
136 PRINT
137 PRINT
160 B$(1)="WALK"
161 B$(2)="SINGLE"
163 B$(3)="DOUBLE"
164 B$(4)="TRIPLE"
165 B$(5)="HOME RUN !!"
166 B(1)=1
167 B(2)=1
168 B(3)=2
169 B(4)=3
170 B(5)=4
200 R=INT(5*RND(3))+1
210 ON R GOTO 220,240,260,280,300
220 PRINT "IT'S A BEAUTIFUL DAY FOR BASEBALL"
230 GOTO 310
240 PRINT "IT SURE LOOKS LIKE RAIN"
250 GOTO 310
260 PRINT "WE HAVE A CAPACITY CROWD TODAY — 40,000 FANS"
270 GOTO 310
280 PRINT "WHAT A POOR TURNOUT — ONLY 1,500 FAITHFUL FANS"
290 GOTO 310
300 PRINT "KEEP YOUR MIND ON THE GAME — NOT ON THE MINI-SKIRT IN THE FIRST ROW"
310 PRINT "THE GAME IS ABOUT TO BEGIN"
320 PRINT
330 FOR I3=1 TO I2
340 FOR H=1 TO 2
350 PRINT T$(H)
355 PRINT
360 O=0
400 X9=100*RND(3)
401 IF X9 <05 THEN P(1)=0:GOTO 410
402 IF X9 <55 THEN P(1)=1:GOTO 410
403 IF X9 <85 THEN P(1)=2:GOTO 410
404 IF X9 <95 THEN P(1)=3:GOTO 410
405 P(1)=4
410 PRINT "YOUR NUMBER";
420 INPUT P(2)
421 IF P(2) <=4 GOTO 425
422 PRINT "YOUR NUMBER MUST BE BETWEEN 0 AND 4 — TRY AGAIN"
423 GOTO 420
425 PRINT" MY NUMBER IS ";P(1)
430 IF P(1)=P(2) GOTO 480
440 O=O+1
442 IF O >1 GOTO 450
444 PRINT O;"OUT"
446 GOTO 460
450 PRINT O;"OUTS"
460 IF O=3 GOTO 600
470 GOTO 400
480 PRINT B$(P(1)+1)
485 T(1)=1
490 FOR I=1 TO B(P(1)+1)
500 FOR J=4 TO 1 STEP -1
510 T(J+1)=T(J+1)+T(J)
520 T(J)=0
530 NEXT J
540 NEXT I
550 GOTO 400
600 I(H,I3)=T(5)
610 S(H)=S(H)+T(5)
620 L=0
630 FOR I=1 TO 4
640 L=L+T(I)
650 T(I)=0
660 NEXT I
670 T(5)=0
680 IF H=2 GOTO 710
690 PRINT:PRINT "TOP ";
700 GOTO 720
710 PRINT:PRINT "BOTTOM";
720 PRINT "OF INNING";I3
730 PRINT "SCORE: VISITORS";S(1);"HOME TEAM";S(2)
```

```
740 PRINT L;"LEFT ON BASE"
745 PRINT
750 PRINT
755 PRINT
760 NEXT H
770 NEXT I3
780 PRINT "FINAL SCORE: VISITORS";S(1);" HOME TEAM";S(2)
781 PRINT"INNING      1   2   3   4   5   6   7   8   9"
782 PRINT
783 PRINT USING "VISITORS    ## ## ## ## ## ## ## ## ##";I(1,1),I(1,2),I(1,3),I(1,4),I(1,5),I(1,6),I(1,7),I(1,8),I(1,9)
784 PRINT USING "HOME TEAM ## ## ## ## ## ## ## ## ##";I(2,1),I(2,2),I(2,3),I(2,4),I(2,5),I(2,6),I(2,7),I(2,8),I(2,9)
785 PRINT:PRINT
790 IF S(1) <> S(2) GOTO 820
800 PRINT"TIE GAME"
810 GOTO 900
820 IF F=1 GOTO 850
830 IF S(1) > S(2) GOTO 880
840 GOTO 860
850 IF S(1) < S(2) GOTO 880
860 PRINT "THE ";N$;" WIN!!"
870 GOTO 900
880 PRINT "THE HEXADECS WIN!!"
900 PRINT "PLAY AGAIN";
910 INPUT Y$
915 IF Y$="Y" GOTO 20
920 IF Y$="YES" GOTO 20
930 PRINT "THANKS FOR THE GAME — SEE YOU LATER"
940 PRINT:PRINT
980 END
```

```
RUN
WHAT IS YOUR NAME? IRV

THIS IS A BASEBALL GAME BETWEEN THE IRVS AND THE HEXADECS.
WE ARE PLAYING FOR THE COMPUTER LEAGUE PENNANT SO PLAY YOUR BEST.

HOW MANY INNINGS SHOULD WE PLAY? 3
I'M THE VISITING TEAM
DO YOU NEED INSTRUCTIONS? N
IT'S A BEAUTIFUL DAY FOR BASEBALL
THE GAME IS ABOUT TO BEGIN

** HEXADECS ARE UP **

YOUR NUMBER? 2
MY NUMBER IS 3
 1 OUT
YOUR NUMBER? 1
MY NUMBER IS 2
 2 OUTS
YOUR NUMBER? 1
MY NUMBER IS 1
SINGLE
YOUR NUMBER? 4
MY NUMBER IS 2
 3 OUTS

TOP OF INNING 1
SCORE: VISITORS 0 HOME TEAM 0
 1 LEFT ON BASE

** IRVS ARE UP **

YOUR NUMBER? 3
MY NUMBER IS 1
 1 OUT
YOUR NUMBER? 2
MY NUMBER IS 1
 2 OUTS
YOUR NUMBER? 2
MY NUMBER IS 2
DOUBLE
YOUR NUMBER? 1
MY NUMBER IS 1
SINGLE
YOUR NUMBER? 3
MY NUMBER IS 3
TRIPLE
YOUR NUMBER? 4
MY NUMBER IS 1
 3 OUTS

BOTTOM OF INNING 1
SCORE: VISITORS 0 HOME TEAM 2
 1 LEFT ON BASE

** HEXADECS ARE UP **

YOUR NUMBER? 1
MY NUMBER IS 0
 1 OUT
YOUR NUMBER? 2
MY NUMBER IS 3
 2 OUTS
YOUR NUMBER? 0
MY NUMBER IS 0
WALK
YOUR NUMBER? 2
MY NUMBER IS 0
 3 OUTS

TOP OF INNING 2
SCORE: VISITORS 0 HOME TEAM 2
 1 LEFT ON BASE

** IRVS ARE UP **

YOUR NUMBER? 2
MY NUMBER IS 1
 1 OUT
YOUR NUMBER? 3
MY NUMBER IS 1
 2 OUTS
YOUR NUMBER? 4
MY NUMBER IS 2
 3 OUTS

BOTTOM OF INNING 2
SCORE: VISITORS 0 HOME TEAM 2
 0 LEFT ON BASE

** HEXADECS ARE UP **

YOUR NUMBER? 1
MY NUMBER IS 1
SINGLE
YOUR NUMBER? 2
MY NUMBER IS 2
DOUBLE
YOUR NUMBER? 1
MY NUMBER IS 1
SINGLE
YOUR NUMBER? 3
MY NUMBER IS 1
 1 OUT
YOUR NUMBER? 3
MY NUMBER IS 3
TRIPLE
YOUR NUMBER? 2
MY NUMBER IS 0
 2 OUTS
YOUR NUMBER? 1
MY NUMBER IS 1
SINGLE
YOUR NUMBER? 2
MY NUMBER IS 2
DOUBLE
YOUR NUMBER? 3
MY NUMBER IS 0
 3 OUTS

TOP OF INNING 3
SCORE: VISITORS 4 HOME TEAM 2
 2 LEFT ON BASE

** IRVS ARE UP **

YOUR NUMBER? 4
MY NUMBER IS 2
 1 OUT
YOUR NUMBER? 2
MY NUMBER IS 2
DOUBLE
YOUR NUMBER? 3
MY NUMBER IS 3
TRIPLE
YOUR NUMBER? 2
MY NUMBER IS 1
 2 OUTS
YOUR NUMBER? 2
MY NUMBER IS 1
 3 OUTS

BOTTOM OF INNING 3
SCORE: VISITORS 4 HOME TEAM 3
 1 LEFT ON BASE

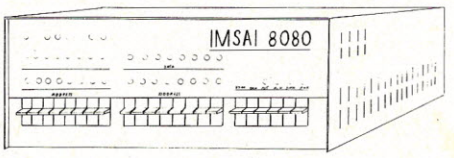
FINAL SCORE: VISITORS 4 HOME TEAM 3
INNING        1  2  3  4  5  6  7  8  9

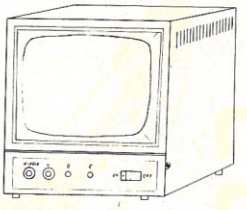
VISITORS      0  0  4  0  0  0  0  0  0
HOME TEAM     2  0  1  0  0  0  0  0  0

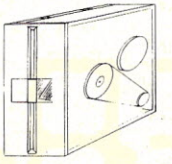
THE HEXADECS WIN!!
PLAY AGAIN? N
THANKS FOR THE GAME — SEE YOU LATER
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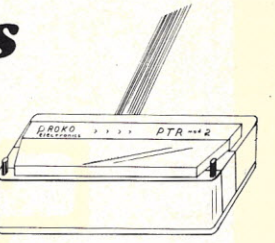
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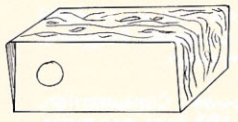
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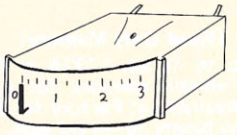
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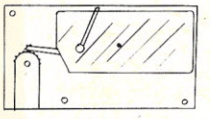
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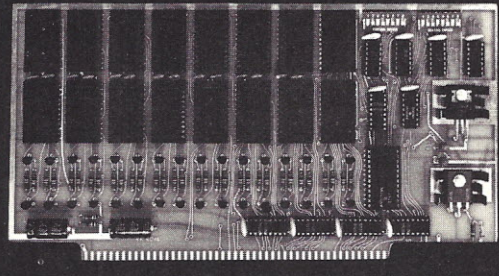
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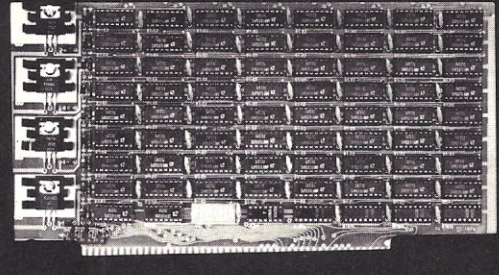
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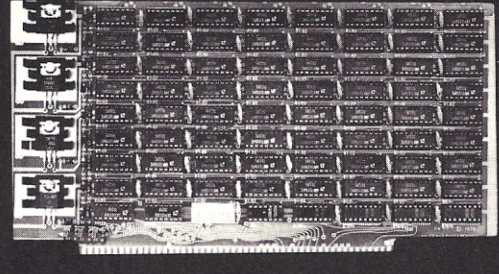
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- ALTAIR®, IMSAI®, and S-100 buss compatible.
- Access Time: 500 nsec max.
- Memory Chip: AMD 91L02APC or 2102AL-4
- Battery Standby: 〉1.5 to 4V〈
- Address Select: 8 ea. SPST Dip Switch
- Wait States: None
- Current Reg.: Less than 200 ma per 1K.
- All Address, Control, and Data Out lines fully buffered.
- All IC's supplied with IC Sockets
- Solder masked, both front and back of P.C. Board
- Component silk-screened on component side of card

Kit Price: $269.00 **Assembled Price: $369.00**

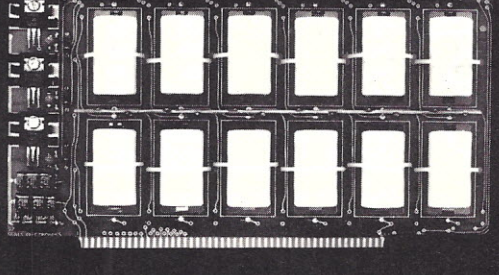


8KSC-Z

Same Specifications as for 8KSC Card Except:

- Access Time: 250 nsec max.
- Zilog Speed Compatible up to 4 mhz.
- Memory Chip: 2102LHPC or 2102AL-2

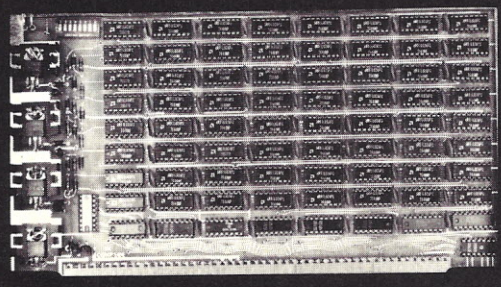
Kit Price: $295.00 **Assembled Price: $395.00**



BBUC [Battery Backup Card]

- Automatic Battery Charging Circuit
- Selectable Standby Voltage Outputs
- Will Hold up to 12 ea. "C" Cell Ni-Cad batteries
- The BBUC comes selected for 2.5 Volts Standby to Pin no. 14 on the Altair or S-100 buss structure to power up our 8KSC-Z Memory Boards.
- Can be Wired to Backup any Memory Card which has Battery Standby Capabilities.
- Eliminates cluge wires on top of memory boards. (Utilizes any vacant buss lines)
- Just Plug the BBUC into any available buss connectors.

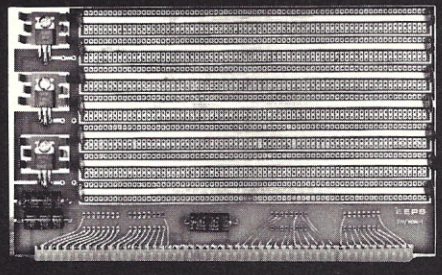
Kit Price: $55.00 **Assembled Price: $68.00**



68KSC [Static Memory Card for SWTPC 6800]

- 8192 Words of Static Memory
- Access Time: 500nsec. (250 nsec on request)
- Memory Chip 91L02 APC or 2102AL-4
- Battery Standby
- Address Selected 8 ea. SPST Dip Switch
- Low Power
- All Lines Buffered.
- All IC's with Sockets
- Solder Mask on both sides of PC Board

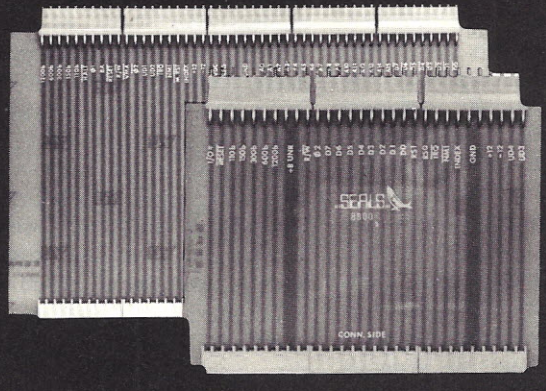
Kit Price $269.00 **Assembled Price $369.00**



68WWC [Wire Wrap Card for SWTPC 6800]

- Contains all Buss Connectors
- Contains 3 ea. Voltage Reg. +12,-12, +5
- Contains 3 ea. 100 uf 35 Volt input Cap.
- Contains a generous supply of .1 12v decoupling capacitors.
- Will accept all popular IC wire wrap sockets 40,24,22,16,14,etc.
- Highest quality proto-typing board on the market today. It has all the basics. You just add your circuit.

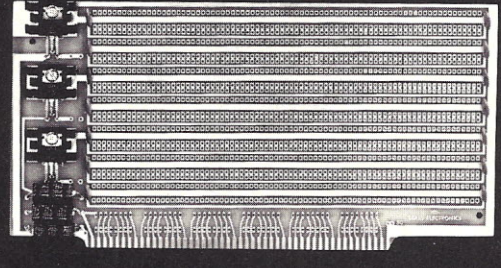
Kit Price $35.00 **Assembled Price $45.00**



68EXT [SWTPC 6800 Compatible Products]

- 68 EXT-S-Small Maintenance Aid Raises any PC Board in SWTPC 6800 Computer.
- 68 EXT-L Maintanance aid to lift Large P.C. Boards above Computer to allow easy access while trouble shooting
- Pin numbers screened on Card
- Both Cards come with all connector hardware

Kit Price	Assembled Price
68 EXT-S - Small $19.00	$25.00
68 EXT-L - Large 29.00	39.00



88WWC [Wire Wrap Card]

- Accepts All IC Sockets
- 3 Voltage Regulators +12, -12, +5V
- 3 Separate Input Capacitors
- Gold Plated Edge Contacts
- Component Layout Screened on Component Side of P.C. Card

Kit Price: $37.50 **Assembled Price: $47.50**

88EXT [EXT Card] NOT SHOWN

- Maintenance Aid raises any S-100 buss PC Board above the computer to allow easy access while trouble shooting
- Contains one PC Board screened with pin numbers for easy identification
- Comes with 100 pin edge connector.

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Using an Invisible PROM

... how to relocate monitor programs

Jack Regula
2 Meadow Dr.
Freeville NY 13068

If you've ever experienced the frustration of not being able to load a particular piece of software because your monitor is sitting down in page zero, you're gonna love this! Jack has come up with a couple of simple cures for the problem . . . and the techniques should apply to Digital Group and other systems, as well as Altair bus machines. — John.

Most microcomputer users will agree to the desirability of having a monitor program in PROM that is executed automatically at power-on. Such a program would initialize the system, then input the desired applications program from the cassette or other storage device (i.e., it would bootstrap the desired program in). It would also contain commonly used input/output subroutines and short routines to allow entering and debugging of machine language programs. With a monitor to allow entry and execution of high level commands at the terminal instead of low level commands at an Altair style front panel, you'll never key in another bootstrap loader. Modification of someone else's programs for your own use will be made much simpler by the I/O subroutines stored in the PROM.

The Problem, and a Solution

The problem with a PROM monitor, as commonly conceived, is its incompatibility with hobbyist software. BASIC and many editor and assembler programs distributed through hobbyist channels execute in locations 0000 and up. Consequently, RAM must be located at the same addresses where the PROM would have to reside. This is because the reset, which occurs at power-on, causes the microprocessor to start executing the program stored at location 0000. Ideally, one would have PROM at this base address at power-on and RAM there afterward. Such a PROM would be there when needed, but invisible to the applications program.

A very simple technique can, in effect, change a microprocessor's reset vector (the address to which its program counter is set by a reset) from 0000 to FC03 (hex). A schematic for accomplishing this is shown in Fig. 1. The output of a shift register temporarily disables the Tri-state buffer for the six highest-order bits of the address bus. Pull-up resistors make these bits 1s instead of 0s for the first three memory reads after a reset. This, in effect, jams a new reset vector, FC00, onto the address bus. As a result, the first instruction executed after reset is whatever is stored at FC00 (hex). If the instruction in FC00 is a JMP to FC03H, the program stored there (FC03 and up) will execute just as if the reset vector were to that same address.

Ah Yes, There's Another Way . . .

An alternate implementation shown in Fig. 2 involves modifying the memory boards rather than the CPU board. One gate forces a chip select to the PROM at FC00

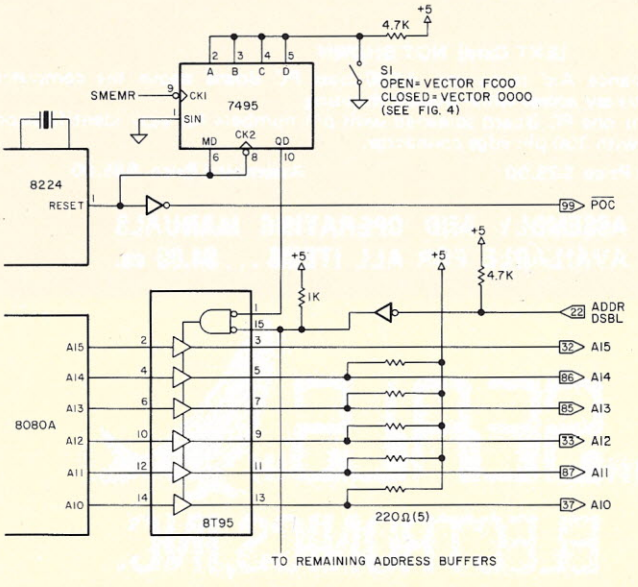


Fig. 1. Circuit to change reset vector by adding shift register and pull-up resistors and replacing the 8T97 with an 8T95. This should complete the modification for most CPU boards. (All mnemonics and connector pin numbers are for Altair bus.)

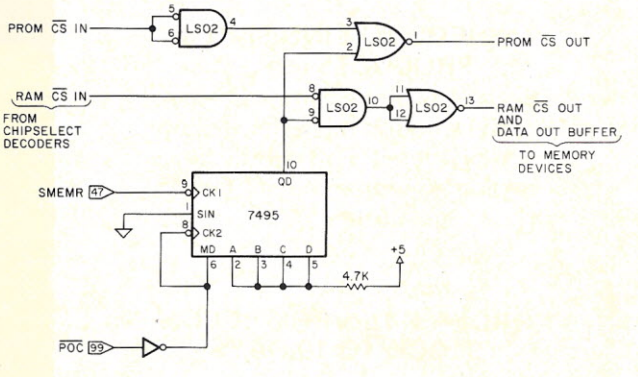


Fig. 2. Alternate invisible PROM ingredients involve modifying memory boards rather than the CPU board.

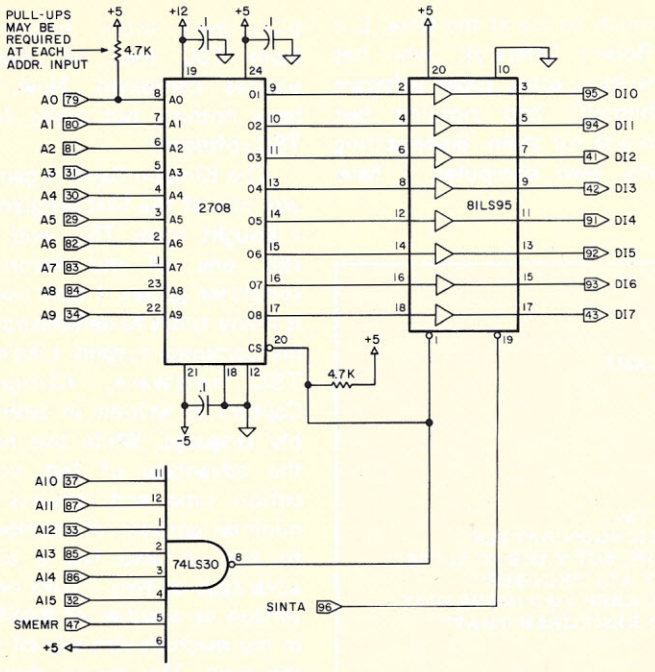


Fig. 3. Interfacing a PROM to the Altair bus. Data bus buffer can be shared with other PROMs or input ports on board.

whenever the shift register's output is high, while another prevents the RAMs at 0000 from receiving one. Note that for most (static) memory devices, delaying the chip select as shown will not cause the access time to increase. Check your schematics to see which approach is easiest for you to implement.

The switch shown in Fig. 1

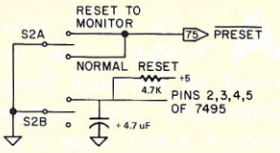


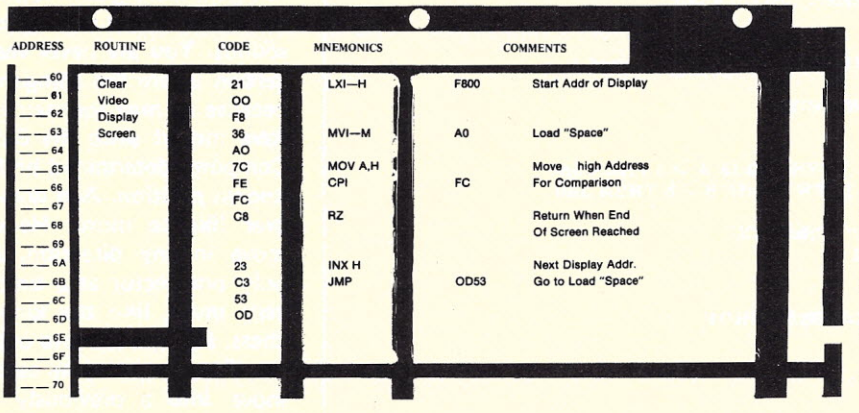
Fig. 4. Suggested reset switch wiring.

(S1) gives you a choice of reset vectors. With the switch closed, the system will work just as it did before modification. This will allow you to use your reset switch to restart BASIC, once you've managed to load it successfully. This suggests using a momentary action double-pole, double-throw toggle switch with a center off position for the reset switch. Pushing it up would jump you to the monitor. Pushing it down would get you to the program stored starting at 0000. Fig. 4 shows how to wire the reset switch.

Fig. 3 gives the fundamentals of wiring in a PROM. The address bus is connected to the address inputs of the PROM and to a 7430 NAND gate which decodes a chip select. The Altair bus status signals SMEMR and SINTA are included in the logic function to prevent potential bus conflicts. Unless a bipolar PROM is used, you'll need the Tri-state buffer shown on the schematic. Consider the ultraviolet erasable 2704 and 2708 PROMs for this application. They're fast, easily programmed, and recent appearance of second sources should bring about a rapid price decline.

Unlike other techniques which change the address at which a chip select is decoded for the PROM, this PROM never moves, so its subroutines are available for use by other programs without relocation. Given its simplicity and ease of incorporation into just about any 8080 or Z80 based microcomputer system, there is little reason to delay wiring it in. Do so and the advantages of having an invisible PROM will be quite easy to see. ■

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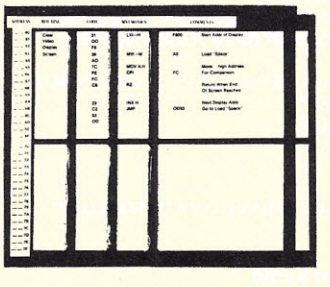
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At the 1976 Atlanta Hamfest I was introduced to Technical Systems Consultants' fine software. Since I didn't have a computer, it didn't mean very much to me at the time. But Robert Uiterwyk (who has written some super software himself) had nothing but praise for them. Since getting my own computer, I have purchased more software from TSC than all other sources combined. Now, I have nothing but praise for TSC software!

The Klingon Capture game was one of the first programs I bought from TSC, and is still one of my favorite computer games. I have used it many times to demonstrate my computer system. Like all TSC software, Klingon Capture is written in assembly language. While this has the advantage of fast execution time and requires a minimal amount of memory to run, it also has a disadvantage or two. I have one version or another of BASIC in my machine virtually all of the time. This means that I lose BASIC when I load the Klingon Capture game into the machine (both use low memory) I then have to reload BASIC to do something else after playing the game. It seemed much less bother to write a version of the game in BASIC, so here it is.

In Klingon Capture, unlike Startrek, you don't want to kill the Klingon. To win, you must capture him alive. You do this by destroying all of the sectors surrounding the Klingon, leaving him nowhere to move. It isn't as easy as it sounds. You are never really certain where the Klingon is, because he may (or may not) have moved since the Battle Computer determined his last known position. And does he ever like to move! He can move in any direction, but only one sector at a time — very much like the king in chess. He cannot move out of the Quadrant, and he cannot move into a previously destroyed sector.

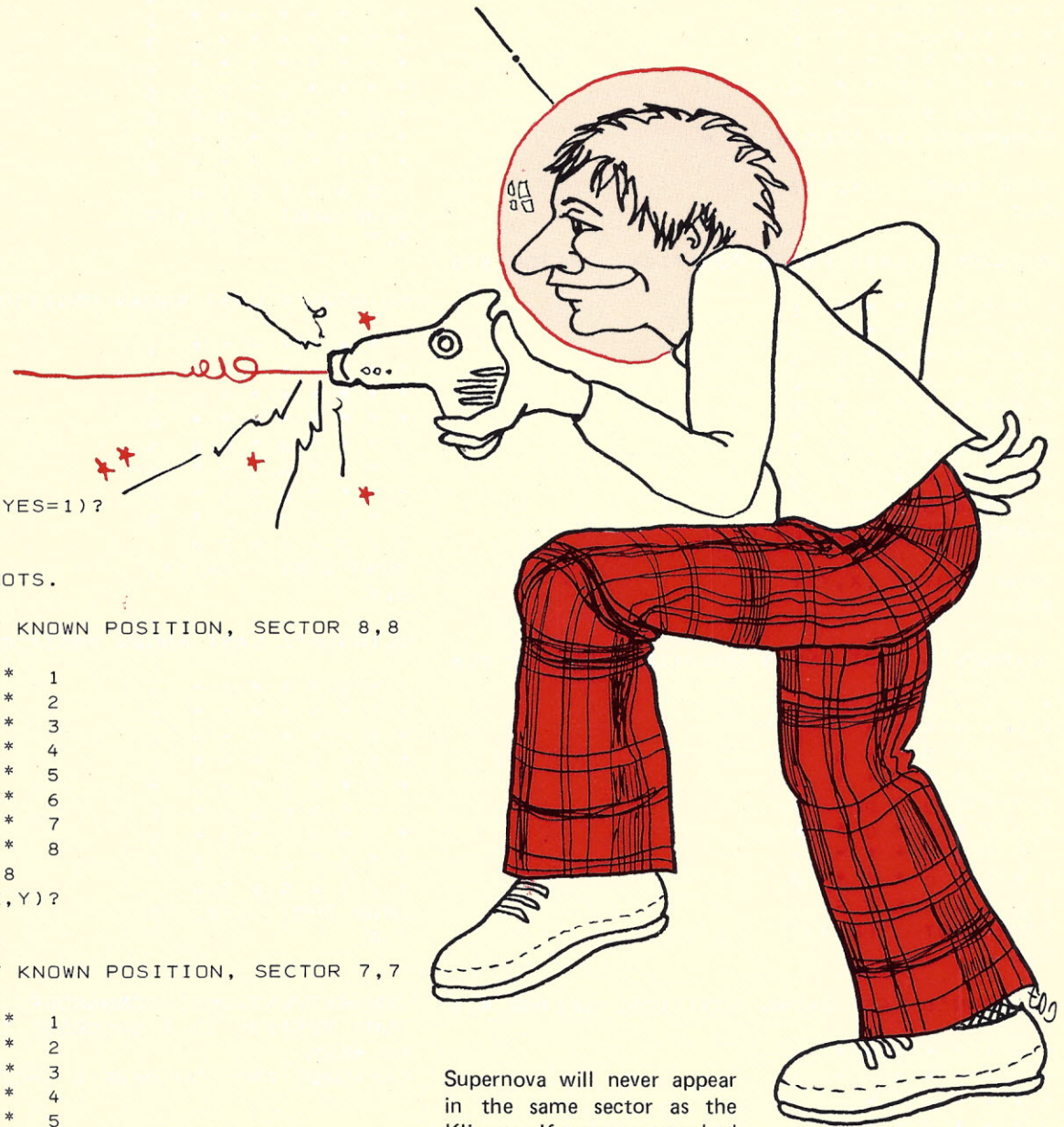
You have an (approximate) 5% chance of Supernovas appearing in the Quandrant or of being attacked by the Klingon. A Supernova destroys the sector in which it appears. Therefore it is very much like getting an extra shot, except the location of the Supernova is determined (at random) by the computer, not by you. A

```
10 REM          KLINGON CAPTURE
20 REM          BASED ON TSC'S 6800 MACHINE LANGUAGE GAME
30 REM          WRITTEN IN TSC'S MICRO BASIC PLUS
40 REM                  BY
50 REM          MICKEY E. FERGUSON
60 REM
65 REM LINE 70 GETS YOU 15 — 20 SHOTS
70 S=RND/5:IF S <15 THEN 70:IF S >20 THEN 70
80 PRINT:INPUT "INSTRUCTIONS (YES=1) ",I:IF I <>1 THEN 150
90 PRINT "YOUR MISSION, COMMANDER, IS TO CAPTURE A KLINGON BATTLE"
100 PRINT "CRUISER. YOU MUST NOT DESTROY THE KLINGON, BUT TAKE IT ALIVE."
110 PRINT "TO CAPTURE THE KLINGON, YOU MUST DESTROY ALL SECTORS"
120 PRINT "SURROUNDING IT. THE BATTLE COMPUTER WILL KEEP YOU INFORMED"
130 PRINT "OF ITS LAST KNOWN POSITION. GOOD LUCK AND REMEMBER THAT"
140 PRINT "WE ARE COUNTING ON YOU, COMMANDER."
150 PRINT:PRINT "YOU HAVE ";S;" SHOTS.":PRINT
155 REM INITIALIZE QUADRANT
160 DIM Q(9,9)
170 FOR X=0 TO 9:FOR Y=0 TO 9:Q(Y,X)=0
180 Q(0,X)= -1:Q(9,X)= -1:Q(Y,0)= -1:Q(Y,9)= -1:NEXT Y:NEXT X
185 REM LINES 190 — 200 GET KLINGON'S INITIAL POSITION
190 X=RND/10:IF X <1 THEN 190:IF X >8 THEN 190
200 Y=RND/10:IF Y <1 THEN 200:IF Y >8 THEN 200
205 REM PRINT KLINGON'S "PRESENT" POSITION
210 PRINT "KLINGON'S LAST KNOWN POSITION, SECTOR ";X;" , ";Y:PRINT
215 REM MOVE KLINGON (MAYBE)
220 IF S <= 0 THEN 530:C=X:D=Y
230 A=RND/10:IF A <C THEN X=X-1:IF A >C THEN X=X+1
240 IF X <1 THEN X=1:IF X >8 THEN X=8
250 A=RND/10:IF A <D THEN Y=Y-1:IF A >D THEN Y=Y+1
260 IF Y <1 THEN Y=1:IF Y >8 THEN Y=8
270 IF Q(Y,X) <>-1 THEN 280:X=C:Y=D:GOTO 230
275 REM PRINT MAP
280 FOR A=1 TO 8:FOR B=1 TO 8
290 IF Q(B,A)= 0 THEN PRINT "* ";
300 IF Q(B,A)= -1 THEN PRINT "0 ";
310 NEXT B:PRINT SPC(1);A:NEXT A
320 FOR A=1 TO 8:PRINT A;SPC(1);:NEXT A:PRINT
325 REM CHECK TO SEE IF BEING ATTACKED (5% CHANCE)
330 A=RND:IF A >4 THEN 370
340 PRINT "THE ENTERPRISE HAS BEEN ATTACKED."
350 PRINT "PHASOR ENERGY USED TO REPLENISH SHIELDS.":S=S-1
360 PRINT S;" SHOTS REMAIN.":PRINT
365 REM CHECK FOR SUPERNOVA (5% CHANCE)
370 A=RND:IF A <94 THEN 420
375 REM LOCATE SUPERNOVA
380 A=RND/10:IF A=X THEN 380:IF A <1 THEN 380:IF A >8 THEN 380
390 B=RND/10:IF B=Y THEN 390:IF B <1 THEN 390:IF B >8 THEN 390
400 Q(B,A)= -1
410 PRINT "SUPERNOVA IN SECTOR ";A;" , ";B:PRINT
420 INPUT "YOUR SHOT (X,Y) ",A,B:S=S-1
425 REM CHECK IF YOU SHOT KLINGON
430 IF A=X THEN IF B=Y THEN 540
435 REM CHECK IF SECTOR HAS ALREADY BEEN SHOT
440 IF Q(B,A)= -1 THEN 580:Q(B,A)= -1
445 REM CHECK TO SEE IF YOU WIN
450 FOR A=X-1 TO X+1:FOR B=Y-1 TO Y+1
460 IF A=X THEN IF B=Y THEN 480
470 IF Q(B,A) <>-1 THEN 210
480 NEXT B:NEXT A
490 PRINT "CONGRATULATIONS! COMMANDER!"
500 PRINT "YOUR MISSION IS A SUCCESS! THE KLINGON HAS BEEN"
510 PRINT "CAPTURED AND YOU HAVE ";S;" SHOTS REMAINING!"
520 END
530 PRINT "PHASORS OUT OF ENERGY. NO SHOTS LEFT.":GOTO 560
540 PRINT "CONGRATULATIONS, DUMMY!"
550 PRINT "YOU JUST FRIED THE KLINGON!"
560 PRINT "YOUR MISSION IS A TOTAL LOSS!"
570 END
580 PRINT "NICE GOING, DUMMY!"
590 PRINT "YOU JUST SHOT A PREVIOUSLY DESTROYED SECTOR!"
600 GOTO 210
```

Program listing.

Klingon Capture Game

. . . bring 'em back alive !



Sample run.

```
$RUN

INSTRUCTIONS (YES=1)?
0

YOU HAVE 17 SHOTS.

KLINGON'S LAST KNOWN POSITION, SECTOR 8,8

* * * * * * * *  1
* * * * * * * *  2
* * * * * * * *  3
* * * * * * * *  4
* * * * * * * *  5
* * * * * * * *  6
* * * * * * * *  7
* * * * * * * *  8
1 2 3 4 5 6 7 8
YOUR SHOT    (X,Y)?
5,5

KLINGON'S LAST KNOWN POSITION, SECTOR 7,7

* * * * * * * *  1
* * * * * * * *  2
* * * * * * * *  3
* * * * * * * *  4
* * * * 0 * * *  5
* * * * * * * *  6
* * * * * * * *  7
* * * * * * * *  8
1 2 3 4 5 6 7 8
YOUR SHOT    (X,Y)?
6,5
```

Supernova will never appear in the same sector as the Klingon. If you are attacked by the Klingon, phasor energy will be used to replenish the ship's shields. This means you lose a shot. If the phasors run out of energy, and you have not captured the Klingon, you lose the game. If you shoot the Klingon, you lose. Good hunting! ■

```
KLINGON'S LAST KNOWN POSITION, SECTOR 6,8

* * * * * * * *  1
* * * * * * * *  2
* * * * * * * *  3
* * * * * * * *  4
* * * * 0 * * *  5
* * * * 0 * * *  6
* * * * * * * *  7
* * * * * * * *  8
1 2 3 4 5 6 7 8
YOUR SHOT   (X,Y)?
5,8

KLINGON'S LAST KNOWN POSITION, SECTOR 7,7

* * * * * * * *  1
* * * * * * * *  2
* * * * * * * *  3
* * * * * * * *  4
* * * * 0 * * 0  5
* * * * 0 * * *  6
* * * * * * * *  7
* * * * * * * *  8
1 2 3 4 5 6 7 8
SUPERNOVA IN SECTOR 3, 8

YOUR SHOT   (X,Y)?
5,7

KLINGON'S LAST KNOWN POSITION, SECTOR 8,6

* * * * * * * *  1
* * * * * * * *  2
* * * * * * * 0  3
* * * * * * * *  4
* * * * 0 * 0 0  5
* * * * 0 * * *  6
* * * * * * * *  7
* * * * * * * *  8
1 2 3 4 5 6 7 8
SUPERNOVA IN SECTOR 6, 7

YOUR SHOT   (X,Y)?
8,5

KLINGON'S LAST KNOWN POSITION, SECTOR 8,6

* * * * * * * *  1
* * * * * * * *  2
* * * * * * * 0  3
* * * * * * * *  4
* * * * 0 * 0 0  5
* * * * 0 * 0 *  6
* * * * * * * *  7
* * * * 0 * * *  8
1 2 3 4 5 6 7 8
YOUR SHOT   (X,Y)?
7,5

KLINGON'S LAST KNOWN POSITION, SECTOR 8,7

* * * * * * * *  1
* * * * * * * *  2
* * * * * * * 0  3
* * * * * * * *  4
* * * * 0 * 0 0  5
* * * * 0 * 0 *  6
* * * * 0 * * *  7
* * * * 0 * * *  8
1 2 3 4 5 6 7 8
YOUR SHOT   (X,Y)?
6,6

KLINGON'S LAST KNOWN POSITION, SECTOR 7,6

* * * * * * * *  1
* * * * * * * *  2
* * * * * * * 0  3
* * * * * * * *  4
* * * * 0 * 0 0  5
* * * * 0 0 0 *  6
* * * * 0 * * *  7
* * * * 0 * * *  8
1 2 3 4 5 6 7 8
YOUR SHOT   (X,Y)?
7,7

KLINGON'S LAST KNOWN POSITION, SECTOR 8,7

* * * * * * * *  1
* * * * * * * *  2
* * * * * * * 0  3
* * * * * * * *  4
* * * * 0 * 0 0  5
* * * * 0 0 0 *  6
* * * * 0 * 0 *  7
* * * * 0 * * *  8
1 2 3 4 5 6 7 8
YOUR SHOT   (X,Y)?
8,7

KLINGON'S LAST KNOWN POSITION, SECTOR 8,8

* * * * * * * *  1
* * * * * * * *  2
* * * * * * * 0  3
* * * * * * * *  4
* * * * 0 * 0 0  5
* * * * 0 0 0 *  6
* * * * 0 * 0 *  7
* * * * 0 * 0 *  8
1 2 3 4 5 6 7 8
YOUR SHOT   (X,Y)?
8,8

KLINGON'S LAST KNOWN POSITION, SECTOR 7,8

* * * * * * * *  1
* * * * * * * *  2
* * * * * * * 0  3
* * * * * * * *  4
* * * * 0 * 0 0  5
* * * * 0 0 0 *  6
* * * * 0 * 0 *  7
* * * * 0 * 0 0  8
1 2 3 4 5 6 7 8
YOUR SHOT   (X,Y)?
7,8

CONGRATULATIONS! COMMANDER!
YOUR MISSION IS A SUCCESS! THE KLINGON H
AS BEEN
CAPTURED AND YOU HAVE 6 SHOTS REMAINING!
```

WE PAY POSTAGE!

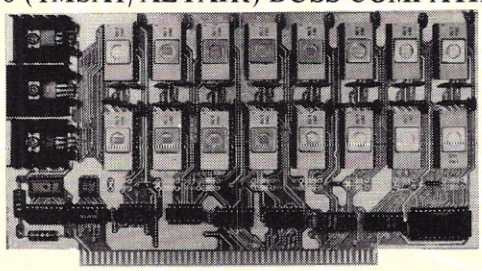
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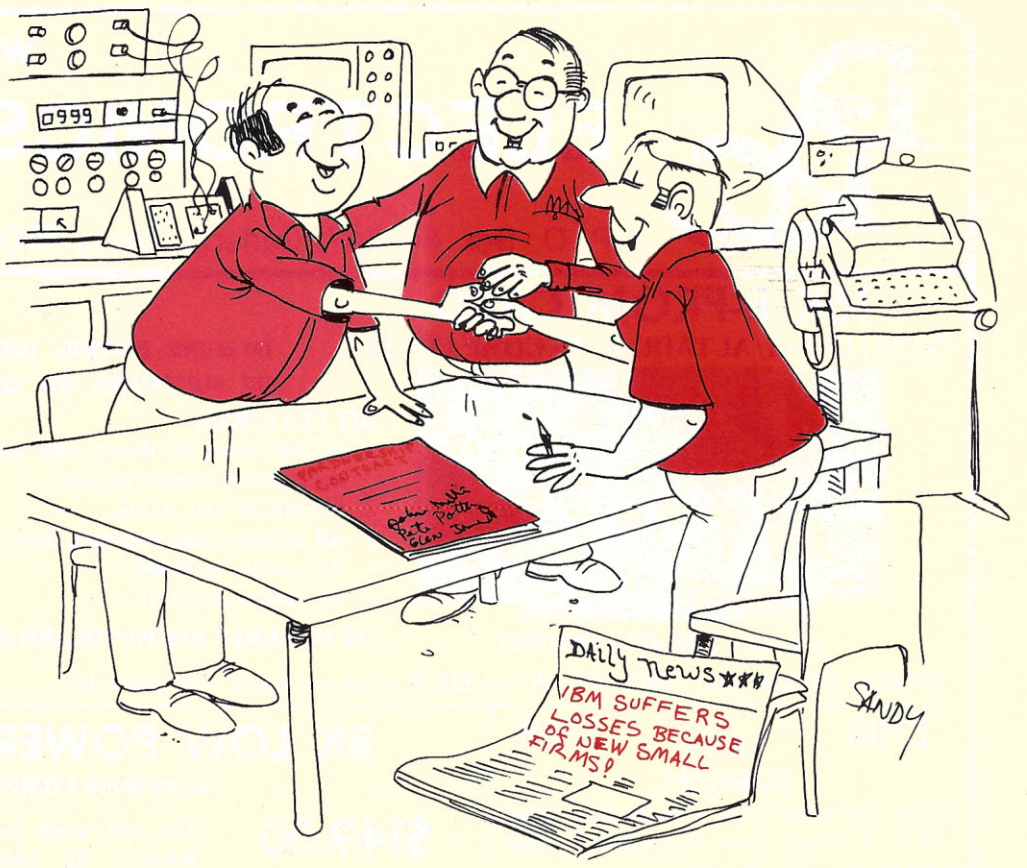
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Homebrew computing is, or soon will be, the great modern American cottage industry. It has all the characteristics: 1. widely available raw materials – kluge cards and chips and wire and solder, etc.; 2. modest capital investment; 3. labor-intensive; 4. any native may enter (perhaps after suitable rites of indoctrination and initiation).

It is expected that the industry will be characterized by a large number of small producers. The nature of the enterprise and the philosophy of the entrepreneurs resist transition to large-scale operations. At the same time, most computer hobbyists are willing to share – perhaps must share (witness the growth of clubs) their equipment and expertise.

The "Problem"

It is my observation that most computer hobbyists with entrepreneurial ambitions cannot work effectively on their own, and in fact they do not. This may reflect natural divisions in the industry. There are hardware types and software types, business types and creative types.

Consequently, I conclude that collaboration on a small scale is going to be a feature of the industry for some time to come. I am writing this to pass on some of my experiences with small-scale collaboration in the industry.

The following conversation is not entirely fanciful, and I think that many will be reminded of similar scenarios involving themselves or others they have heard about.

"Jack, I want to talk with you. I have heard that you just made a deal with IDM. Is that . . ."

"Oh, yes, Ed. They are going to put my disk controller into production and market it under their Homespun label. And I have also agreed to write some supporting software for them. They gave me an advance on royalties."

"Congratulations, Jack. However, all that is part of what we have been doing together. You ought to have talked to me about it first."

"Oh, no, Ed. You and I talked about developing a cassette system. What I have been negotiating with IDM about is quite separate from our work. It is nothing to do with you . . ."

"But Jack, you have been using all my equipment to develop that board, and we have talked about the overall system quite often. We talked most about the cassette system only because we had agreed to give it priority. There was never any intention to make that our only project.

"Ed, you're wrong. I bought all the parts for the prototype board myself, and it was basically my idea."

"When we started to work together, Jack, our aim was just to develop products that would use the Pace chip. In my view, everything that either of us has worked on since then belongs to both of us – even though I've put up most of the capital. You can't just decide that you'll have this piece and I'll have that piece."

"I don't agree at all, Ed. You just want to grab a piece of the action after I've done all the work. I might just as easily have done everything on my own."

Solution: Get it in Writing

The main point is that a misunderstanding or dispute like that just depicted is unnecessary.

Any time you work with other people, you should ask yourself, "Is this work being done for profit, or in contemplation of profit?" If the answer is yes, or perhaps even maybe, you should formalize the working and business relationship. It is not so much that the formalities will protect you; rather, they will force you and your collaborators to think about future contingencies and make the terms of collaboration explicit and mutually understood. Another reason for formalizing an apparently business-like relationship is that you probably have a legal entanglement anyway, so you may as well plan it and control it properly.

Suppose you want to formalize the relationship and other people do not. My advice to you would be to terminate the existing work relationship. There are no good reasons not to have a formal relationship, so a refusal or reluctance to settle on one should be taken as a sign that a more serious disagreement will eventually surface. Trying to formalize a vague situation usually clarifies it. Clarifying who is supposed to do what, when and how is a valuable accomplishment for the people involved.

So, let us assume that you have agreed to put something in writing that will indicate a business relationship between you and some other people. The first decision is what kind of formal relationship to have, and that is essentially the choice between a general partnership and a corporation. How you choose will depend on your particular

Starting a Business ?

... pitfalls to avoid

situation, but I observe that most hobbyists collaborate on a casual basis and would not wish to organize a corporation until money was actually flowing. This suggests one possible solution to the problem of choice. Have a partnership until such time as a corporation becomes more desirable — until, for example, products are being sold. This contingency should be spelled out in the partnership agreement.

Rather than giving a list and discussion of the relative advantages of corporate and partnership forms of business, such as you might find in a business textbook, I will concentrate on taking an existing business relation and formalizing it as partnership. Then I will discuss some aspects of the corporate form of business organization. Since I live in California, as do a large number of *Kilobaud* readers, I am going to describe the California procedures. Other states will have similar procedures and regulations, but their actual burden varies significantly.

The Partnership

First, a general comment. At several points in this discussion I will suggest that you consult an attorney. A strong reason for not doing so is the expense but that is not a sufficient reason. The fact is we live in a very complex society and personal computers are some of its most complex products. Rules of commerce are imposed whether we like them or not, and attorneys are the experts in this area. Because computer hobbyists may be the ultimate do-it-yourselfers, they probably need to be warned more than others that law is not a do-it-yourself proposition.

You may have a partnership already. A written agreement is not necessary to form a partnership. In some cases a partnership has been found to exist even when the partners had never discussed forming a partnership and later wished to deny that there had been a partnership. The basic test is whether the people intended to co-own a business for profit. The important consequences of being in a partnership are that the partners incur responsibility for each other's actions in connection with the partnership business and that each partner assumes a position of trust with respect to the interest of the other partners. Partnerships should clearly not be entered into lightly. Yet a casual cooperation engaged in with the intention of sharing ultimate profits will ordinarily be sufficient to create a partnership.

Since you may have all the obligations and consequences of being a partnership anyway, it is better to plan the business relationship as soon as possible after you have entered into it, if not before. It is better to have the provisions you want rather than those that will be inferred from the circumstances or those imposed by general legal considerations.

To formalize a partnership, it is advisable to draw up and sign a partnership agreement, to choose a name, and to register the fact that you are doing business under that name.

The Partnership Agreement

The agreement should cover the important matters, and the prospect of signing the agreement will force the partners to decide what in fact are the important matters. Many misunderstandings will come out and, with luck, be settled. An agreement generally covers the purpose of the business, the capital to be contributed by each partner, the division of profits and losses, the form of accounting and the records and reports that are to be made, rules for the exercise of control and decision-making, and procedures for dissolution and transfer of a partnership interest.

You should think about the inevitability of change in the partnership. One of the major drawbacks of a partnership is that it is unstable. Unless provision is made for change in the membership of the partnership, the death of a partner, or withdrawal of a partner will automatically trigger the dissolution of the partnership, including a division of assets. A fair division of the results of a joint project is very elusive indeed. You can avoid this potenitally destructive and contentious outcome by suitable provisions in the partnership agreement. The partnership should provide a method to appraise any partner's share and to enable the partnership or one of the remaining partners to buy out a withdrawing partner without the necessity of dissolution proceedings. Such agreements quickly become very technical. You should have the assistance of an attorney who is experienced in devising such provisions. If you can't afford an attorney something in writing is better than nothing.

It is prudent to acknowledge that disputes are probably inevitable, too. You should try to prevent disputes leading to lawsuits. It will help to head off trouble if you have at least three partners with control distributed so that a minority cannot control the decision-making. In the limit, with three partners, any two should be able to outvote the third. Thus, *de facto* control is effectively allied with social persuasion, tending to maintain a very stable system. Even so, disputes will still arise, and lawsuits may be contemplated. An alternative is binding arbitration, and the agreement can provide for binding arbitration for all disputes that cannot otherwise be settled. Arbitration can be a quite simple, fast and informal proceeding if care is taken to prescribe the form of arbitration in the agreement. One formula that

seems to work well is for each side to choose a representative, who then choose a third. They resolve the dispute, after investigation, by majority vote.

In small organizations personal property of members is usually donated. There is often vagueness or disagreement as to whether a transfer was a donation or a loan. The ownership of such personal property should be made explicit. With initial capital assets this can be done in the partnership agreement. Later donations should be entered immediately on the list of assets of the partnership, unless the asset is being temporarily loaned, in which case the terms should be noted in writing. You do not want Joe to quit and repossess "his" microprocessor or "his" scope unless everyone has agreed to this in advance.

Everyone should be warned that written documents do not prevent disputes, or necessarily help in settling them. People can and do break written as well as verbal agreements, and a verbal agreement is not necessarily less binding than a written agreement. The value of a written agreement is that its composition has forced the parties to think about all these matters, and indeed to have completed a successful negotiation.

Choosing a Name

Although you may choose any name for the partnership, it is advisable not to pick a name that is similar to the name of another organization, especially one in a similar business.

You must register your name with the County Recorder. The Recorder does not check to see whether the name you have chosen is already being used by some other concern. After becoming known by a particular name, you may have to give it up when the sound-alike company finds out about you.

Obtain a Fictitious Business Name Statement from the County Recorder, fill it out and register it — that is, give it back to the Recorder, who will keep it as an official record. The form is a simple one-page statement. It recites the basic facts that so-and-so are doing business as a partnership (in this case) under the name of such-and-such. Filing costs you $10.

The fact that you are doing business under that name is supposed to be published in a newspaper of general circulation in your county. Several local papers check the county records and will probably contact you and offer to perform the service of publication.

Bank Account

You have a partnership agreement and a fictitious name duly registered with the county recorder. So now you are in business. You should open a bank account. Even if your account has very low volume, it establishes records for tax and general business purposes. It is important also that you create a good credit rating for your business.

When you open a bank account under a name that is not your own, the bank will want proper authority. If the business is not incorporated, the bank will have to be satisfied that a fictitious business name statement has been filed and published as required by law.

The Corporate View

Establishing a partnership is rather like getting married. The act establishes certain rules of ownership, sharing and mutual responsibility. The union, however, is more in the Moslem than the Christian mold, unless the partnership agreement is carefully devised so that the partnership can be dissolved only be mutual agreement.

On the other hand, establishing a corporation is more like giving birth. You create a new individual who has a life of her own. Her owners and controllers may change, but she will usually survive so long as any of the owners (shareholders) wish. A corporate form is more suitable for mature businesses. Its permanence is more appealing to certain entrepreneurs.

Many advisors will tell you that limited liability is a major advantage of the corporate form. In other words, your risk is limited to what your share of the company is worth. Your personal worth beyond that is not imperiled if your associates in the company incur a large liability. However, many people are in business without being incorporated and for a small enterprise the advantage of limited liability is largely illusory. Most corporate law denies the advantage of limited liability to an incorporator with insufficient assets; you cannot hide behind the corporate form.

State law largely governs corporate organization, and regulations vary from state to state. So, if you decide to incorporate, you have a choice of many different states, or even foreign countries. Most hobbyists will want to incorporate, if at all, in their home state, and will have to follow the local regulations. Some may wish to incorporate in a state that is more hospitable to corporate interests. Delaware has such a reputation, and there is a popular book which gives the procedure and forms for incorporating in Delaware. Before the reader incorporates in another state, however, he should be aware of his home state's laws regarding the regulation and taxing of foreign (i.e., out-of-state) corporations. If you reside and do business in California, there is no longer any apparent advantage to having a foreign corporation.

Regardless of state, corporations are highly regulated. Statutes direct that decisions be made at meetings held at particular times, with required notice and numbers present, and under proceedings according to certain rules. Record-keeping and reporting requirements are specific and complex. The statutes are designed for running companies like Motorola, not Dick and Jane's Pong Palace. Fortunately, many states have special, less formal requirements for small corporations, or so-called "close corporations". California did not formerly have close corporations by statute, but it does now. The law provides special treatment for incorporation by a small number of owners (10 at most) who will govern the business through general agreements (written). The red tape that wraps a corporation has been minimized by the new law for small corporations, making such a form of organization seem much more suitable for the type of business we have been talking about.

Assuming that you have decided to incorporate, what do you do next? The procedures are similar for different states. I will describe the California regulations.

Since you may have all the obligations and consequences of being a partnership anyway, it is better to plan the business relationship as soon as possible . . .

The Incorporation Process

The new California Corporations law which went into effect on 1 January 1977 substantially simplified the procedure for incorporation. Minimal articles of incorporation can be written on one page. Everything else, such as election of directors and appointment of officers, may be done through the by-laws.

The Secretary of State administers incorporation. You can obtain information and sample articles of incorporation from the Secretary of State, 111 Capitol Mall, Sacramento CA 94814, (916-445-1768). You can find out over the phone (916-322-2387) whether a particular corporate name is available (not yet in use). The Los Angeles office of the Secretary of State can provide some of these services.

A corporation pays a minimum of $200 a year franchise fee. The first year's fee is payable at the time of incorporation. In addition, there is a $65 filing fee. Therefore, it is possible, though perhaps not wise, to incorporate without benefit of professional assistance, for $265. An attorney or business advisor will incorporate your business in a fairly standard package for $200 to $500 in addition to the state fees.

Your corporation exists from the time the articles are filed. However, the corporation must still issue shares. It is the Commissioner of Corporations, not the Secretary of State, who administers the law relating to issuance of shares. You must make sure that the offering and sale of shares is exempt from the burdensome qualifying and reporting requirements of federal and state securities laws. It is virtually impossible to do this without the services of an attorney, so you may as well engage one early in the process of incorporating.

Patent Your Product?

A prosperous company creating high technology products should retain or frequently consult a patent attorney. A good patent attorney will be able to explain to an individual what is and is not patentable.

For example, the possible ways of connecting logic gates is finite, and anyone can connect them. If, however, a few logic gates are connected to perform some useful job, the combination is not necessarily unpatentable.

Regardless of your preconceived ideas about patentability, and of what the laws and regulations say, the best way to get a good impression of patentability is through a search of actual patents related to the product you have in mind. Patents are carefully cataloged and cross-referenced by the Patent and Trademark Office, and may be searched at any of the 22 libraries around the country.

The two in California are in the Los Angeles and Sunnyvale Public Libraries. And the main library is in Arlington, Virginia; patent searches may be conducted there too.

If you cannot get to the library (or even if you can), you can obtain an initial patent search for about $200. Patent attorneys do this, but the person you employ does not have to be a patent attorney.

The Patent and Trademark Office itself is a source of valuable information on procedure. For information write to the Patent and Trademark Office, Washington, D.C. 20231.

A word of caution, though. You may spend more time and money on a patent than it is worth. Being first, and being in possession of essential difficult-to-obtain information is an attractive and business-normal alternative to patenting. A patent confers the right to damages if you prevail in a suit after someone steals your product; it does not guarantee that pirates will overlook your product. In cases where no large amounts of money are at stake, litigation is impractical – see the final note of cautions, below.

Where to Get Help

There is a wealth of information available if you know where to find it: 1. Some libraries are very helpful. Sample forms of partnership agreements can be consulted in a law library or a good general library. 2. The Secretary of State's office is usually very helpful to callers. All procedural information is willingly given. 3. Valuable advice on running a small business is available, free, from the Small Business Administration. The SBA has offices in all large towns. One arm of the SBA is the Service Corps of Retired Executives. Since these people come from an active business background, they are very knowledgeable.

Of course, you don't have to do everything on your own. Apart from attorneys, there are small business consulting firms that will, for a fee, hold your hand and set up your partnership or corporation and arrange for proper accounting and reporting for a given period. For a small business, the cost of a one year contract is $500-800. Look under "Business Consultants".

Final Note of Caution

Perhaps you are deterred by the prospect of getting involved with all these technicalities. Remember that having a court unravel your tangled affairs is going to be much more onerous than applying an ounce of prevention. Indeed, one of my purposes here has been to reduce the probability of litigation and to dispel the false notion that litigation is suitable for settling disputes. Some people who have had little contact with courts think that litigation is a practical alternative. The main reason for the impracticality of litigation for most disputes is its cost. In a dispute of the type depicted at the beginning of this article, the estimated cost of a suit, before trial was $10,000. I feel safe in saying that most hobbyists cannot come up with that kind of bread for that kind of gamble.

Another problem with litigation is the difficulty and uncertainty in valuing intellectual and potential commercial products. Even when there is a working prototype, a litigant is more or less obliged to value it in accordance with his interest. At one extreme he says it is worth only the cost of components and construction time. At the other extreme, he says it is worth the present value of projected future profits. But what the jury will decide is not foreseeable.

The high cost and unpredictability of outcome make litigation unattractive, if not positively repellent. All the litigants in the majority of modest cases are bound to lose. Don't be discouraged. I'm not. Does anyone want to join me in marketing a do-it-yourself partnership kit with a microprocessor as a loss-leader? ■

Establishing a partnership is rather like getting married. The act establishes certain rules of ownership, sharing and mutual responsibility.

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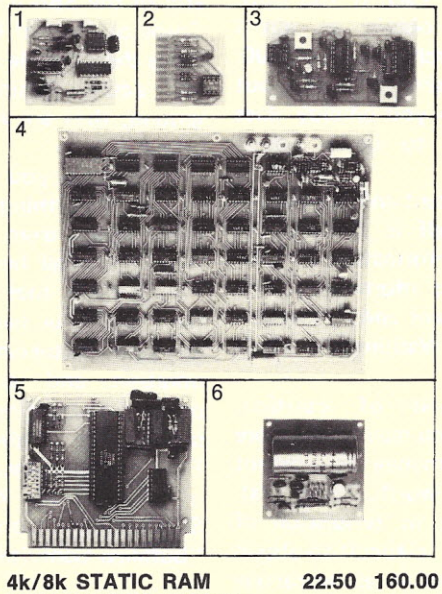
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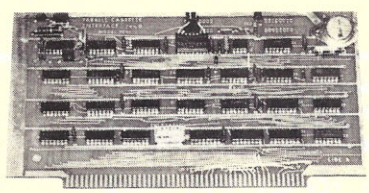
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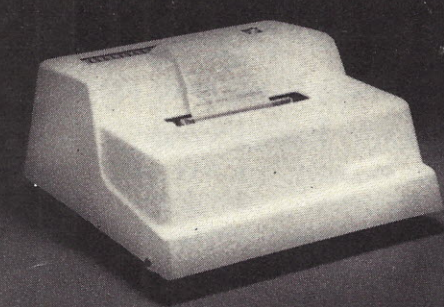
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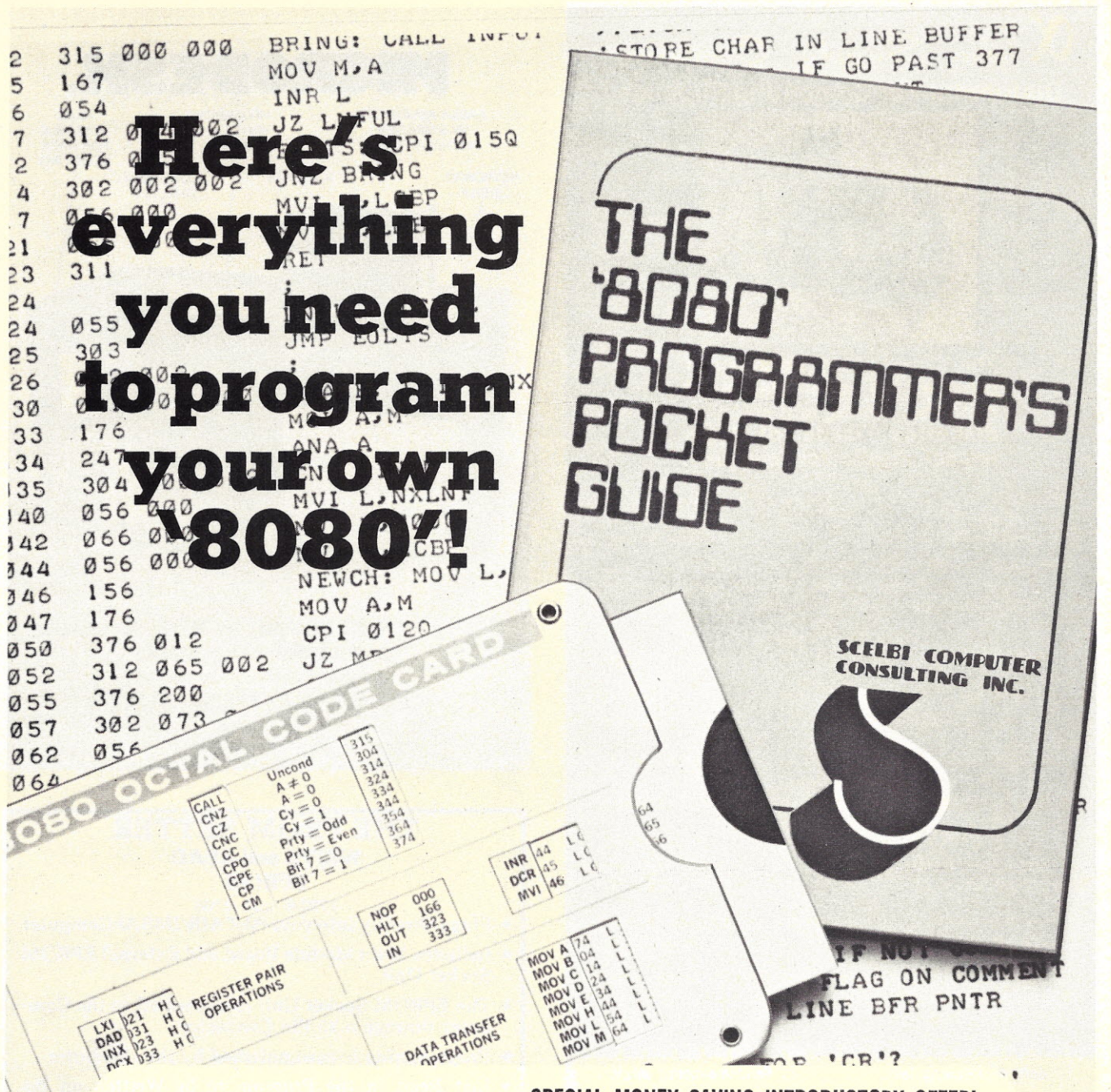
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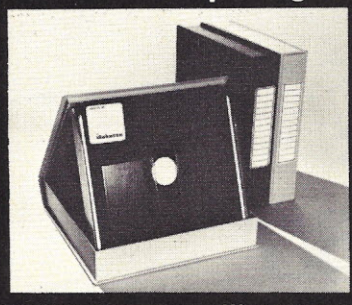
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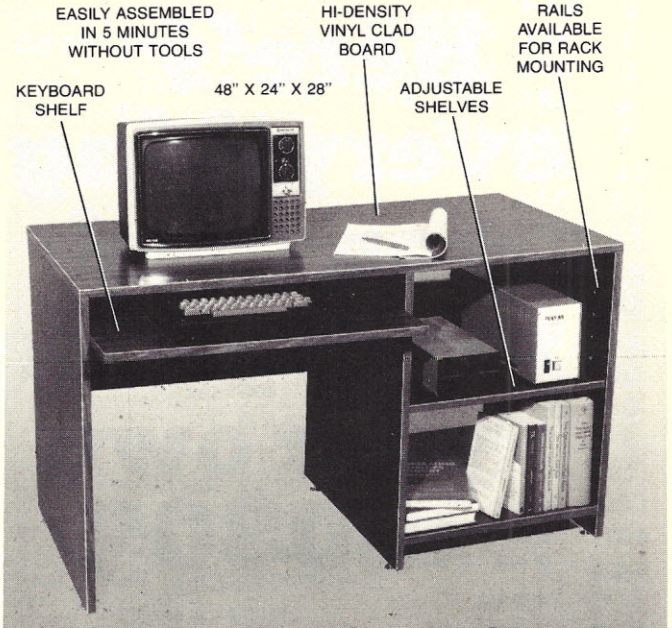
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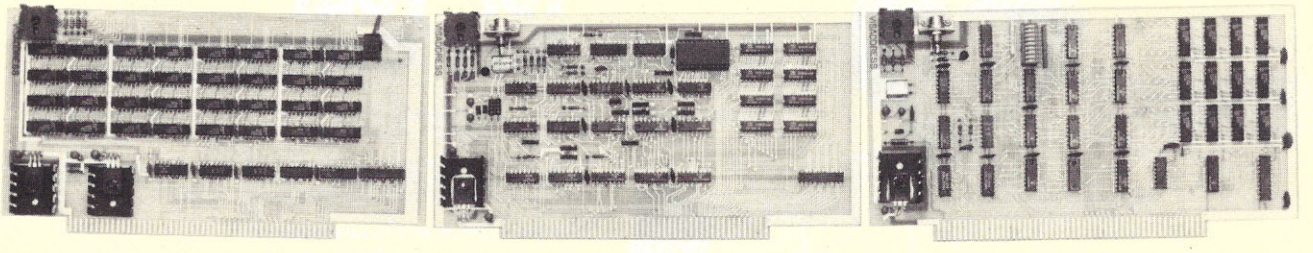
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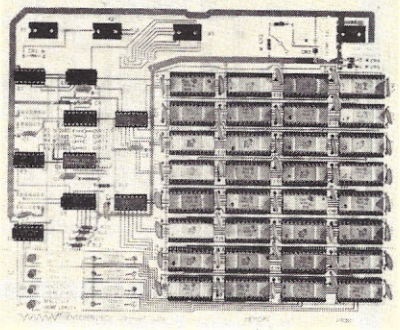
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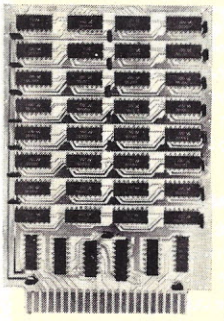
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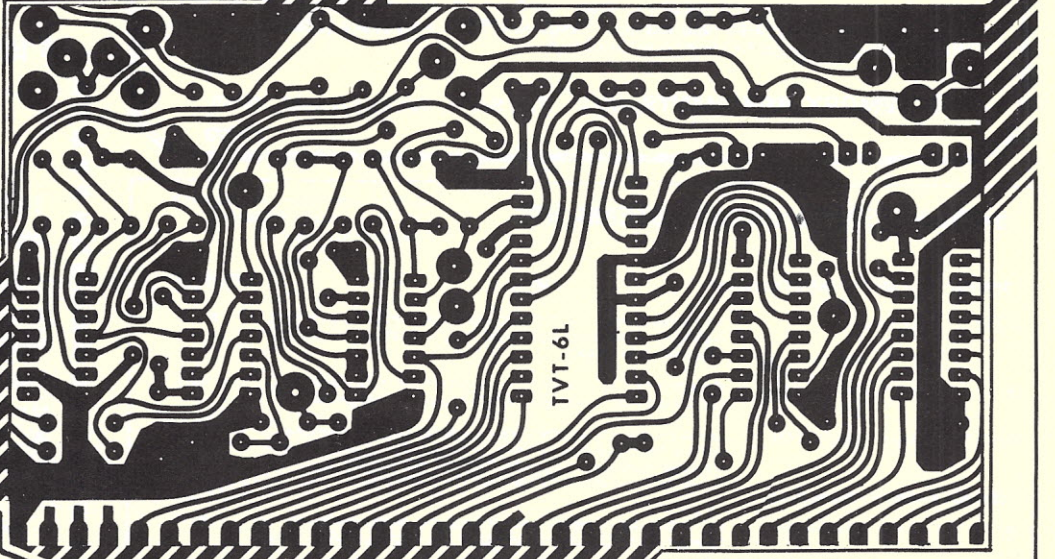
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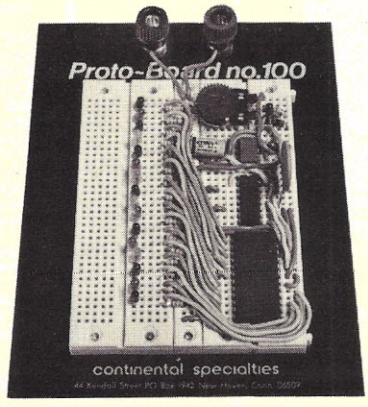
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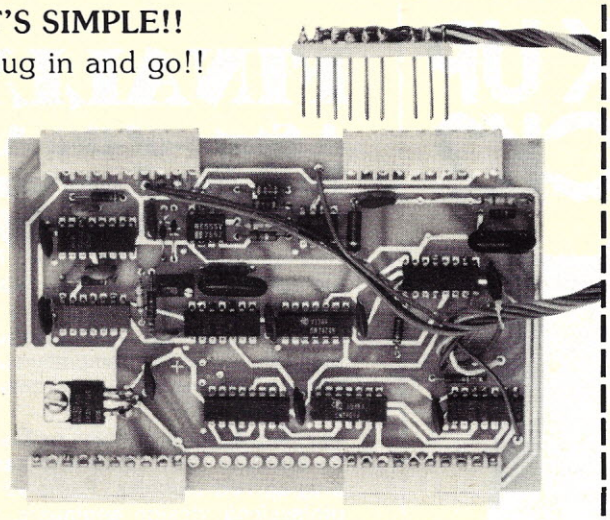


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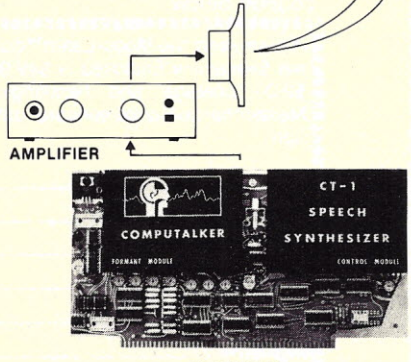
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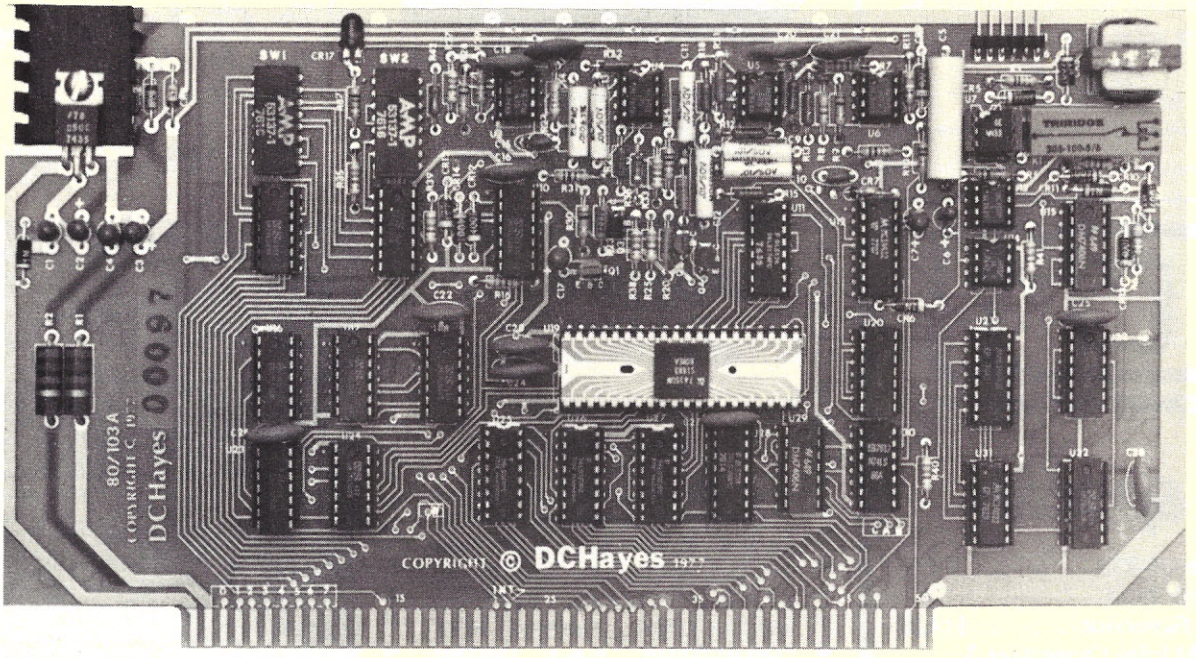
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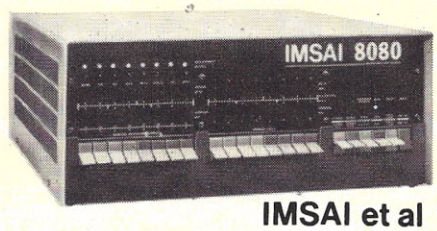
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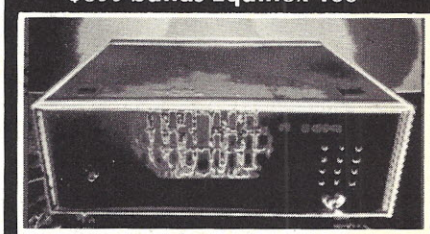
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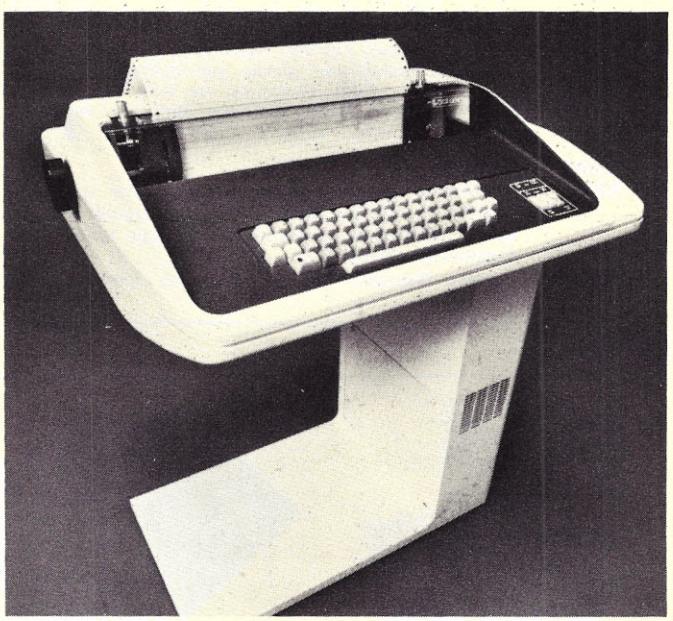
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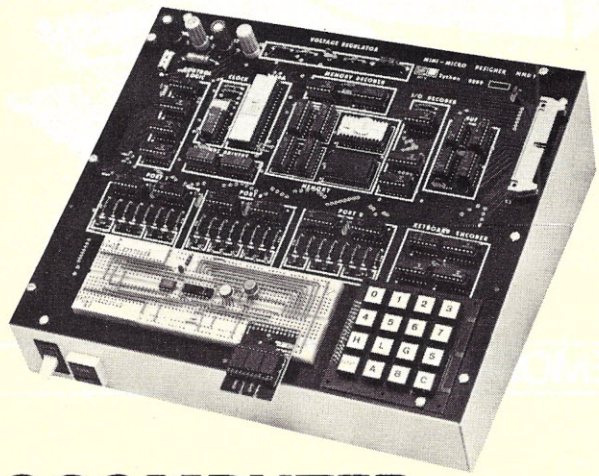
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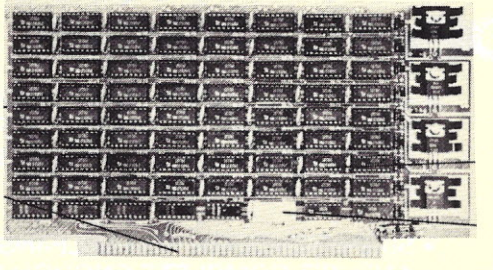
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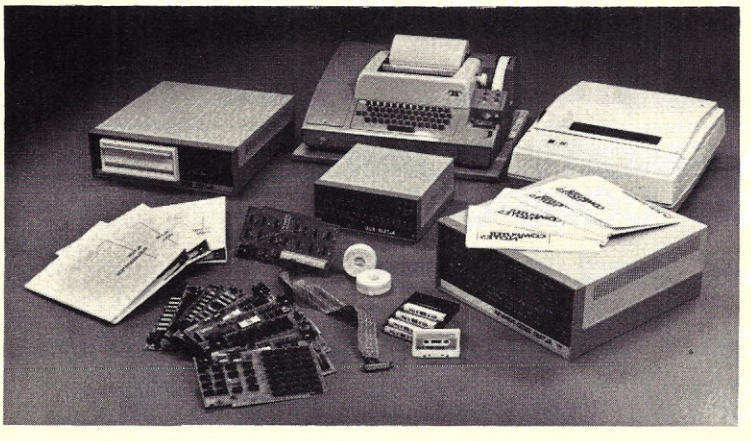
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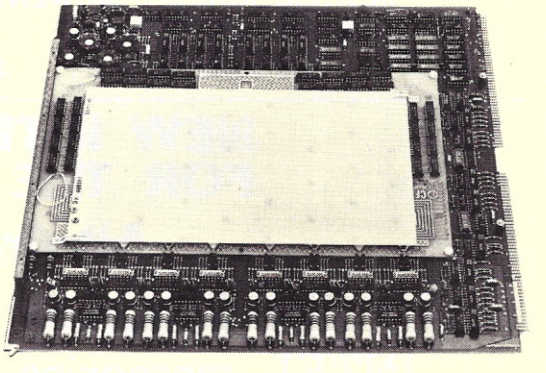
SPECIAL: Limited supply, 16K, Static memories, fully assembled and tested, S100 compatible. Ass'd . . . $650

DATA GENERAL

8K 16 bit-words (16K bytes), 960 ns MOS RAM . . . $950

2K 16 bit-words (4K bytes), PROM . . . $500





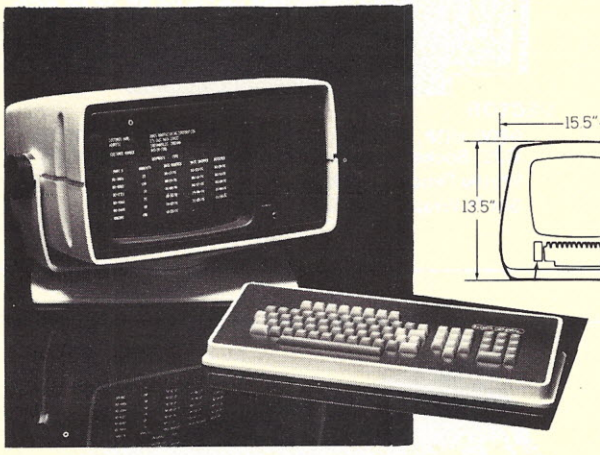
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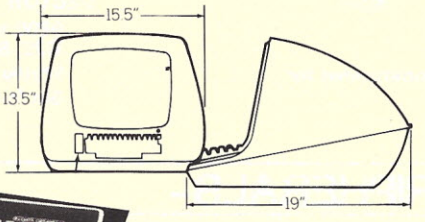
120 CAMBRIDGE STREET, BURLINGTON, MASSACHUSETTS 01803 617-272-8770

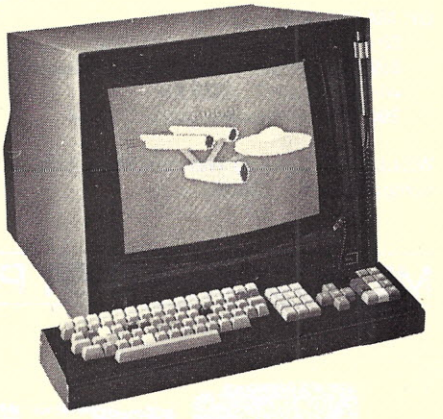
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CRT TERMINALS







DATA GENERAL
6053 Alphanumeric Display Terminal with detachable keyboard. Ass'd ... $2290

LEAR SIEGLER
ADM-3A Assembled ... $1245,
Kit ... $875.00

COMPUCOLOR 8001 SYSTEM
8080 CPU, ROM BASIC, 8K RAM, Keyboard, full color. Ass'd ... $2750.00

PRINTERS–



DATA GENERAL
DASHER, 60 cps, 132 columns, typewriter keyboard, U/L case with EIA or 20 mA interface. Ass'd $2460.00

CENTRONICS
Model 700 60cps, 132 column, 13-19 lpm. Ass'd ... $1520
Model 701 60cps bi-directional, 132 column, 26-120 lpm. Ass'd ... $1815

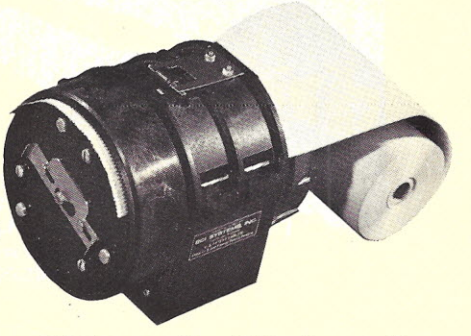
DIGITAL EQUIPMENT DECwriter II/LA-36DE, U/L case, 30 cps, 132 columns. Ass'd ... $1990

☆ NEW
PRODUCT!!!
IMMEDIATE DELIVERY

SCI Systems, Series 1100
Rotary Printer ... $1245
The revolutionary SCI printer has a speed of 2200 characters/sec, 40, 80, 132 characters/line, 24 line format with full ASCII 64 character set in a 4" x 5" x9" package.

The printer is factory assembled and tested and comes with an enclosure and standard RS232-C interface.

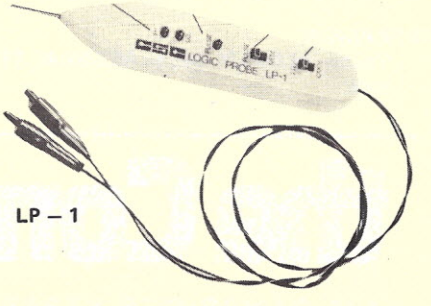
The SCI printer can copy a full 1920 character screen in less than one second.



DESIGNER EQUIPMENT–

E&L INSTRUMENTS
OA3, OP-AMP Designer. Kit ... $102.50. Ass'd ... $155.00
BB4, Universal Powered Breadboard. Kit ... $135.00. Ass'd ... $94.50
DD1, Digital Designer. Kit ... $77.75. Ass'd ... $127.75
For all digital circuit work, includes clock, power supply, logic lights, pulsers, switches and more.

CONTINENTAL SPECIALITIES
LM-1, Logic Monitor ... $74.95 (Ass'd)
Design Mate 4, Pulse Generator ... $124.95 (Ass'd)



LP – 1

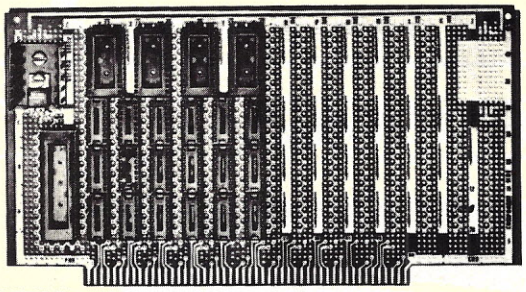
ASSEMBLY TOOLS & AIDS-



BW – 630

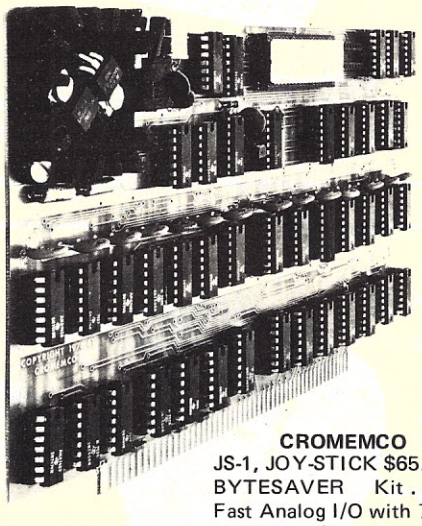
OK MACHINES
SP-50, Solder-Sucker . . . $11.30
BW-630, Hobby-Wrap, Battery powered wire-wrap gun . . . $34.95
3907, Wire-Stripping tool . . . $7.25

WELLER SP23K, 25 Watt Soldering Iron set, recommended for computer kits . . . $8.95

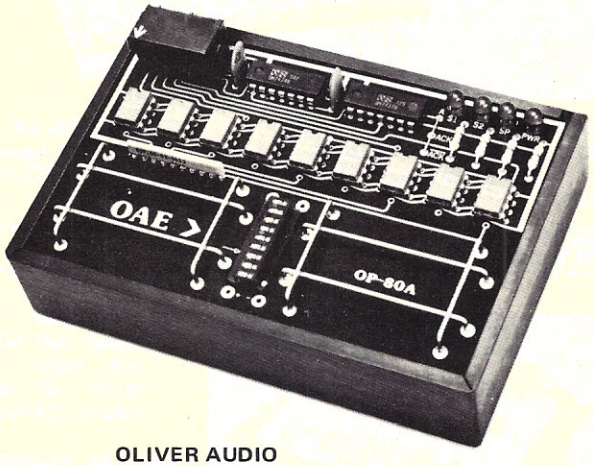


VECTOR
8800 VDP, Altair/Imsai prototype board . . . $19.95
R32, Socket Pins, Gold, Package of 100 . . . $14.95
Wiring Pencil . . . $9.50
Slit 'n Wrap . . . $75.00

MICROCOMPUTER PERIPHERALS-



CROMEMCO
JS-1, JOY-STICK $65.00 (Kit)
BYTESAVER Kit . . . $195.00 Ass'd . . . $295.00
Fast Analog I/O with 7 channels
Kit . . . $145.00 Ass'd . . . $245.00



OLIVER AUDIO
OP-80A, Manual Paper tape reader . . . $74.50 (Kit)

G. Risk Keyboard Kit $59.50

SUPERSCOPE C-103, Audio Tape Recorder . . . $89.95

COMPONENTS

All new SPECIALS
2708 . . . . $25.00/each
1702A $6.50/each
Altair/Imsai 100 pin connectors $7.95
Altair card guides $1.95/pair
Cannon plug set, 25 pin (Male, female, cover) $11.00

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SUPPLIES

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Yellow $4.00/roll, White $5.50/roll, TTY Ribbons: $2.75/ each

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3M
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Data Cartridge, DC100A, mini-cartridge . . . . . $16.00/ea.
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MODEL WD-30



WIRE DISPENSER

- 50 FT. ROLL OF 30 AWG. KYNAR® WIRE-WRAPPING WIRE
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- STRIPS 1 INCH OF INSULATION

AVAILABLE IN FOUR COLORS

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ok wire wrapping center ok

NEW HOBBY WRAP MODEL BW 630



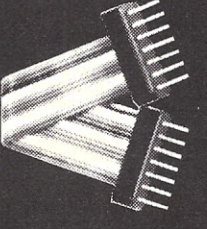
Battery **wire wrapping** tool
ONLY $34.95
COMPLETE WITH BIT AND SLEEVE

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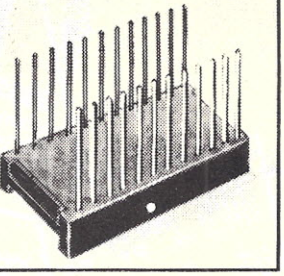


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DIP IC INSERTION TOOL WITH PIN STRAIGHTENER
MODEL INS-1416



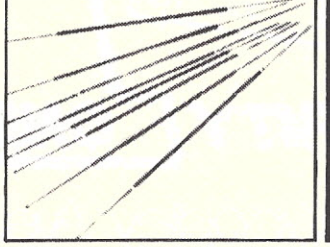
$3.49*

WIRE DISPENSER MODEL WD-30-B

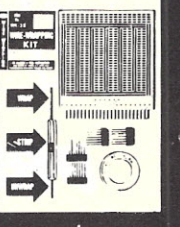


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WIRE WRAPPING KIT



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*MINIMUM ORDER $25.00, SHIPPING CHARGE $1.00, N.Y. CITY AND STATE RESIDENTS ADD TAX

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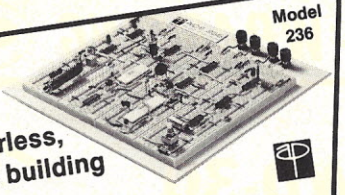
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- Small in size (2x2½x½)
- Push button for seconds release for date.
- Clocks mount anywhere with either 3M double-sided tape or VELCRO, included.
- 2 MODELS AVAILABLE:
  LCD-101, portable model runs on self-contained batteries for better than a year.
  LCD-102, runs on 12 Volt system and is back-lighted.
- LCD-101 or LCD-102 your choice..... **$34.95** ea.
- Clear desk stand for..... **$2.00**

ACE • All-Circuit Evaluator for fast, solderless, plug-in circuit building and testing

Model 236

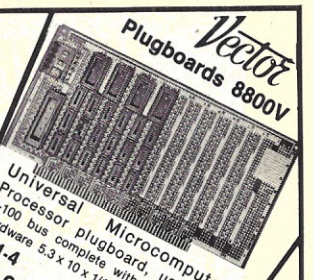


Just plug in any components with leads to .032" dia. Interconnect with solid wire up to 20 ga. Assembled models too!

ACE Model No.	Tie Points	DIP Capacity	No. Buses	No. Posts	Board Size (inches)	Price Each
200-K (kit)	728	8 (16's)	2	2	4-9/16 x 5-9/16	$18.95
208 (assem.)	872	8 (16's)	8	2	4-9/16 x 5-9/16	28.95
201-K (kit)	1032	12 (14's)	2	2	16 x 7	24.95
212 (assem.)	1224	12 (14's)	8	2	4-9/16 x 7	34.95
218 (assem.)	1760	18 (14's)	10	2	6-1/2 x 7-1/8	46.95
227 (assem.)	2712	27 (14's)	28	4	8 x 9-1/4	59.95
236 (assem.)	3648	36 (14's)	36	4	10-1/4 x 9-1/4	79.95

Gold-anodized aluminum base ground; non-corrosive nickel-silver terminals; 4 rubber feet.

Vector Plugboards 8800V



Universal Microcomputer/Processor plugboard, use with S-100 bus complete with heat sink & hardware 5.3 x 10 x 1/16".

1-4 **$19.95** 5-9 **$17.96** 10-24 **$15.96**

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With Rechargeable Batteries & Charger Unit



- 15 megahertz bandwidth.
- External and internal trigger.
- Time base — 1 microsec. to 0.5 Sec/div - 21 settings ±3%.
- Battery or line operation.
- Automatic & line sync modes.
- Power consumption — 15 watts.
- Vertical Gain — .01 to 50 V/div - 12 settings ±3%.
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- Parts & Labor guaranteed 1 year
- 10 to 1, 10 meg probe..... **$24.50**
- Leather carrying case..... **$30.00**

100 K Joypots



$4.95

SLIT-WRAP

Wraps insulated wire on .025" square posts FOUR TIMES FASTER than regular manual wrap-post tools

with two 100' spools of 28 ga. wire **$24.95**



Vector

NO PRE-STRIPPING*
NO PRE-CUTTING*
SPOOL-FED WIRE*

*The spooled wire passes through the tool past a slitting edge next to the wrap post. A narrow longitudinal cut is made in the insulation where it presses the square post corner, the bared copper is indented by the sharp edge. (7 turns = 28 contacts)

Insulation is slit where wrapped but not between terminal posts when led straight out of the tool.

P160-4T includes charger, wire **$75.00**

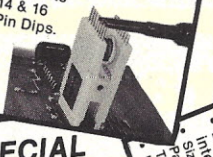


"Daisy-chain" runs
Reliable and easy to use
Manual or power operation

IC TEST CLIPS

TC-14 3 in. **$4.50**
TC-16 3 in. **$4.75**

TC-16 fits 14 & 16 Pin Dips.



LEDU $15.95 SPECIAL

Model XL-334A Econo-Lamp List 23.00



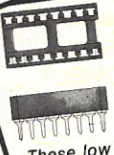
Popular low-priced lamp tubular steel, spring balanced arms; vented shade; tension control knobs; 33" reach UL listed 60 watt. Colors: Red, Yellow, Blue, Black, White, 2 choices pls.

LM3A 3 dig 1% DC ..... $125.
LM3.5A 3½ dig .5% DC ..... $147.
LM40A 4 dig .1% DC ..... $190.
LM4A 4 dig .03% DC $227



- Rechargeable batteries and charger included
- Measures DC Volts, AC Volts, Ohms and Current
- Automatic polarity, decimal and overload indication
- Rechargeable batteries and charger
- Measures DC Volts, AC Volts, Ohms and Current
- Automatic polarity, decimal and overload indication
- Automatic adjustment and no full-scale ohms
- No zero adjustment — NiCad batteries; also AC adjust
- Battery-operated for easy reading without line operation.
- Large LED display for easy reading without interpolation
- Size: 1.9"H x 2.7"W x 4"D
- Parts & labor guaranteed 1 year ..... $ 3.50
- Tilt stand option $16.00
- Leather case

SPECIAL

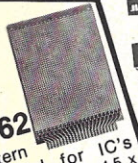


14CS2 100 for $14.00
16CS2 100 for $16.00
14 pin CS2 10 for $2.00
16 pin CS2 8 for $2.00

These low cost DIP sockets will accept both standard width plugs and chips.

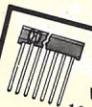
For use with chips, the sockets offer a low profile height of only .125" above the board. These sockets are end stackable.

3662



P pattern plugboard for IC's Epoxy Glass 6.5 x 4.5 x 1/16" 44 pin con. spaced .156" **$6.95**

3 LEVEL GOLD WIRE WRAP SOCKETS



	1-24	25-49	50-99
8 pin	.47	.42	.37
10 pin	.45	.41	.37
14 pin	.39	.38	.37
16 pin	.43	.42	.37
18 pin	.75	.68	.40
22 pin	1.00	.97	.62
24 pin	1.00	.94	.95
28 pin	1.09	.98	.75
36 pin	1.59	1.45	.84
40 pin	1.49	1.39	1.30
			1.29

1/16 VECTOR BOARD

0.1 hole spacing for IC's P pattern

Phenolic PART NO.	SIZE	PRICE
64P44-062XXP	4.5 x 6.5"	$ 1.49
169P44-062XXP	4.5 x 17"	$ 3.51

Epoxy Glass PART NO.	SIZE	PRICE
64P44-062	4.5 x 6.5"	$ 1.97
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with T-9 fluorescent lamp (required) **$49.95**
colors: Gray or Black

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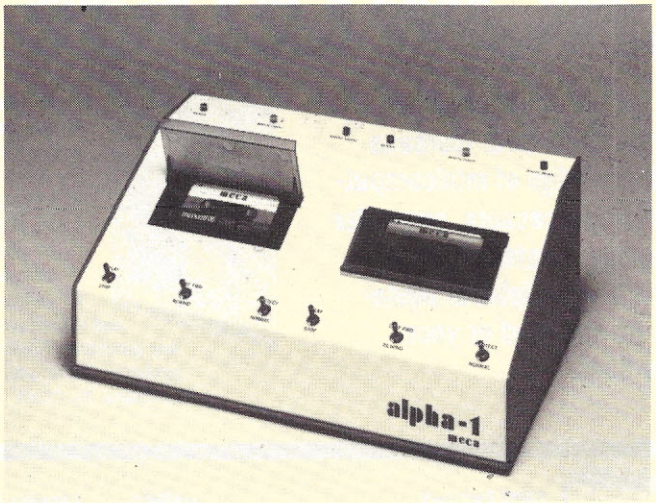
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Prices:		Kit	Assembled & Tested
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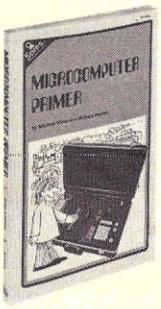
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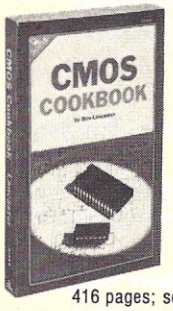
Send for the cookbooks and manuals described. Increase your knowledge of minicomputers, microprocessors, computer technology, related computer circuits and peripheral equipment. Be satisfied or your money back.



How To Buy & Use Minicomputers & Microcomputers
By *William Barden, Jr.*
This manual gives you the basics of minicomputers and microcomputers. Explains their hardware and software, the peripheral devices available and various programming languages and techniques. Allows you to decide which system is best for your needs. 240 pages; softbound. No. 21351 $9.95

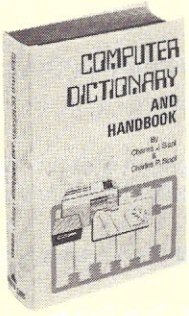


Microcomputer Primer
By *Mitchell Waite* and *Michael Pardee*
Written for the beginner in the computer field. All the basic concepts and characteristics of microcomputers are explored. The easy to understand language prepares you for further study. 224 pages; softbound. No. 21404 $7.95

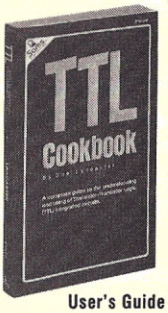


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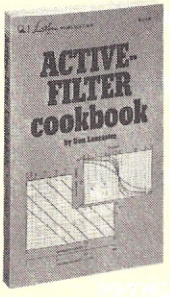


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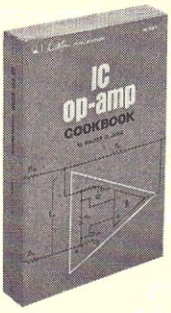
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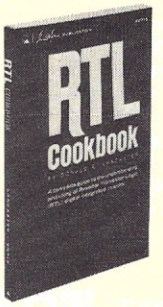
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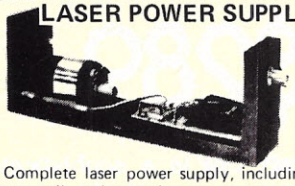


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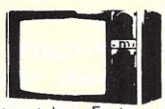


Complete laser power supply, including case, coil, and enough room to mount a laser tube. We have tried it with a Hughes laser tube and it fits easily. This supply should power any 1mW helium-neon gas laser, like those manufactured by B&L, Metrologics, etc. Brand new, boxed.
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TV to MONITOR INTERFACE KIT

TV game board allows interface of any TV as a video monitor for computer use. With power supply & data for 300/75 ohm. Home brew money-saver! 3 Lbs.
7ZU70213 . . . $5.00 ea . . . $27.88 for 5

COLOR "TV" CHASSIS & PARTS



New solid state color TV chassis and parts for use with In-Line black matrix picture tubes. Features include one button color tuning AFC and low power consumption.

We have two chassis types, the TS951 (for 13 & 15") and the TS953 (for 19").

To build a complete 19" TV these parts must be added: UHF & VHF tuners, picture tube, tube shield, purity magnets, antenna, yoke, speaker, on-off switch, 4-10K pots, binding posts & case. To build a 13" or 15" TV you'll have to add: picture tube, tube shield, yoke, purity magnets, antenna, 2nd stage hi-voltage boost, binding posts & case (chassis has tuners).

We do not offer a complete parts package, but we do include full tech. training manual, and we have some parts available.

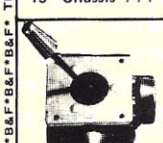
These chassis are new & guarenteed.

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6Z60175	$49.50
15" TV Chassis (w/tuners & controls)	
6Z60174	$49.50
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6Z60172	$29.50
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UHF Tuner (for 19")	6Z60304 . . $2.50
Antenna Telescope	5MI00419 . . $1.50
Binding Post Ass'y	4MI00422 . . $1.50

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17" Chassis	**7DZ70061**	**$14.88**
19" Chassis	**7DZ70062**	**$14.88**



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LOGIC & OP AMP POWER SUPPLY



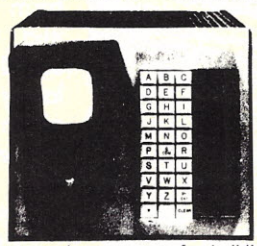
This regulated power supply has outputs of ±15 volts at 0.25 amps and +5 volts at 2.5 amps, with an input of 115 VAC. Manufactured by a computer company as part of a phone data terminal. Three (3) 723's (IC's) are used for voltage regulation. Units have barrier strip outputs, and are open frame. Size: 5" x 9" x 2". New surplus. Qty. Ltd.
Sh. Wt. 5 Lbs . . . 6MI60215 . . . $17.50
3 for $45.00 . . . 6MI60215 . . $45.00/3

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New, packaged ferric chloride crystals in 1 Lb. bags. Use to make 64 oz. of P.C. board etching solution by simply adding water. Our competition sells 6 oz. of this for $3.95 . . . at our low price you get over 10 times as much for $3.00! Quantity is limited.
Sh. Wt. 1½ Lbs. . 7H70258 . . $3.00/bag
4 bags for $10.00 . . . . . $10.00/4 bags

INPUT OUTPUT TERMINAL



A great place to start for building a microprocessor. These units were part of a comlex computer system. The terminal contains: keyboard; CRT; drive circuits; ASC11 output; and a complete 128 page technical manual with operating and repair instructions, which makes it easy to modify the terminal for your applications. (Character generator was part of a separate control section which is not supplied. The terminal can be used when modified using character generator LSI chips, such as the 2513, 2516 or other such IC's).

The keyboard is a 50 key alpha-numeric (and others) block keyboard, with ASC11 output. Display capactiy is 768 (12 lines of 64), 384, 256, 128 and so on, depending on character size desired. The character size may be adjusted from approximately typewriter size up to ¼".

The viewing screen of the CRT utilizes a high contrast, low persistence, emerald green phosphor. Each character is composed from a 5 x 7 dot pattern, registering clearly and sharply against a dark background. Controls provided include: on/off; brightness; focus; and character height.

Great as a microprocessor input & output device. The display stations are used, removed from airline reservation systems, hotel reservation systems, stock exchanges, etc. Sh. Wt. 35 Lbs.
NEVER BEFORE at this LOW PRICE!
6NB60336 . . $29.95 ea . . $100.00 for 4

POWER SUPPLY KITS



1. C.B. POWER SUPPLY KIT
A complete kit which puts out 10 to 24 VDC at 2 amps, regulated, 115 VAC in. Can be wired for contant 13.8VDC, ideal & compact for C.B. Kit includes PC card, components and instructions . . . just add your own case. Super as a bench supply!
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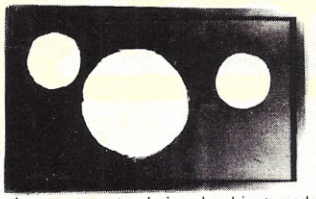
2. 5A, 10 to 24VDC Reg. P.S. KIT
A simple, adjustable regulated power supply. Kit includes all components, vector board and complete schematics. All you add is the case. A powerful supply!
Sh. Wt. 15 Lbs . . . 6MI60301 . . . $14.88

3. 0 to 30V AC/DC P.S. KIT
This high amp adjustable supply is an easy kit to build. It includes a 0 to 40 volt autotransformer (Variac®), 24V 5A transformer and all other components. Useful as a battery charger, bench supply or any use requiring high current.
Sh. Wt. 9 Lbs. . . . 6C60462 . . . $14.50

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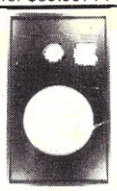
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BOOKSHELF OR FLOOR SPEAKER CABINETS



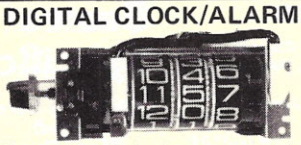
Large computer-designed cabinet made for an 8" woofer, 4" tweeter or midrange and a 3½" tweeter or ducted port (speakers not included). Compact cabinet measures 21" high x 12" wide x 8" deep. Good for floor, wall or bookshelf, just add 2 or 3 speakers, acoustic padding and crossover network. Grill cloth included. A fine pair of cabinets. Sh. Wt. 30 Lb/pr.
7OB70197 . . . . . $25.00/pair
4 pair for $80.00 . . . . . $80.00/4 pair

LARGE SPEAKER CABINET



This enclosure was intended to go into a system that is renowned to be the most accurate medium priced speaker on the market. Size: 25¼" high x 15¼" wide x 9¾" deep. Cabinet will accomadate a 10" woofer, a 4 or 5" midrange and a 4" tweeter. Walnut grained vynal exterior, black vynal front face. Qty. Ltd., With data & grill cloth. Sh. Wt. 18 Lbs. ea.
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Pair for $34.88 . . . . . $34.88/pair

DIGITAL CLOCK/ALARM



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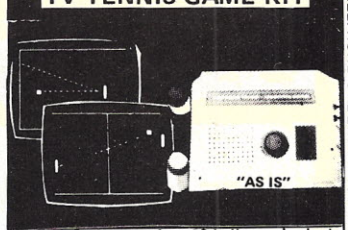


Here's a neat item, brand new and packaged surplus. Great for business, home, baby sitters, people confined to beds, emergencies . . . or just as a convenience. Keep all your most-often-called numbers in memory at all times. Two models available: Home 2001 and Business 3001, (Business 3001 has 40 pin connector for multi-line phones). Sh. Wt. 12 Lbs.
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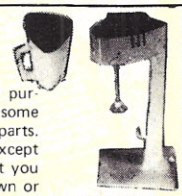
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1 or 2 players - 1 to 10 ball speed - dual paddle size - sound. These games were never finished at the factory. You do a little soldering and mounting to complete the work left undone. The IC board is already assembled and has passed Q.C. Just add some hardware to complete the project: a TV game for under $10. Complete with instructions, qty. ltd. Sh. Wt. 4 Lbs.
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Through a lucky purchase we obtained some new drink mixer parts. We have all parts except the top cover, but you can make your own or operate without it. Now you can build a $20.00 mixer for under $5.00. Great for shakes, kids love 'em. Includes motor, mixer, screws, line cord, stand, switch and 16 oz. mixer cup.
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Spare MIXER CUP for above:
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New, 2 of 8 encoder chip ME8900, (similar to the MC14410). Sold with data sheet on uses of MC14410 chip. No crystals required. Sh. Wt. 8 oz.
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64 - 8x5 characters, 2,560-bit. With data.
Sh. Wt. 8 oz. . . 7IC70231. . . $6.00 ea.

MEMORY CHIPS

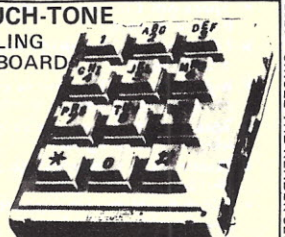
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Sh. Wt. 8 oz. . . . .7IC70173 . . . .$2.00
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3 for $17.00 . . . 7MI70162 . . $17.00/3

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Chomerics Touch-Tone Keyboard - New
Sh. Wt. 8 oz. . . . 5MI00349 . . . .$4.50

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The Bearcat® 210 is a sophisticated scanning instrument with the ease of operation and frequency versatility you've dreamed of. Imagine, selecting from any of the public service bands and from all local frequencies by simply pushing a few buttons. No longer are you limited by crystals to a given band and set of frequencies. It's all made possible by *Bearcat* spaceage solid state circuitry. You can forget crystals forever.

Pick the 10 frequencies you want to scan and punch them in on the keyboard. It's incredibly easy. The large decimal display reads out each frequency you've selected. When you want to change frequencies, just enter the new ones.

Automatic search lets you scan any given range of frequencies of your choice within a band. Push-button lockout permits you to selectively skip frequencies not of current interest. The decimal display with its exclusive "rolling zeros" tells you which channels you're monitoring. When the *Bearcat* 210 locks in on an active frequency the decimal display shows the channel and frequency being monitored.

With the patented track-tuning system, the Bearcat 210 automatically aligns itself so that circuits are always "peaked" for any broadcast. Most competitive models peak only at the center of each band, missing the frequencies at the extreme ends of the band.

The Bearcat 210's electronically switched antenna eliminates the need for the long low band antenna. And a quartz crystal filter rejects adjacent stations as well as noise interference.

Call toll-free 800-521-4414 now to place a BankAmericard or Mastercharge order. This is our 24 hour phone to our order department and only orders may be processed on this line. To order in Michigan or outside of the U.S. dial 313-994-4441.

Add $5.00 for U.S. shipping or $9.00 for air UPS to west coast. Charge cards or money orders only please. International orders invited. Michigan residents add tax. Please write for quantity pricing.

Bearcat® 210 Features

- **Crystal-less**—Without ever buying a crystal you can select from all local frequencies by simply pushing a few buttons.
- **Decimal Display**—See frequency and channel number—no guessing who's on the air.
- **5-Band Coverage**—Includes Low, High, UHF and UHF "T" public service bands, the 2-meter amateur (Ham) band, plus other UHF frequencies.
- **Deluxe Keyboard**—Makes frequency selection as easy as using a push-button phone. Lets you enter and change frequencies easily . . . try everything there is to hear.
- **Patented Track Tuning**—Receive frequencies across the full band without adjustment. Circuitry is automatically aligned to each frequency monitored.
- **Automatic Search**—Seek and find new, exciting frequencies.
- **Selective Scan Delay**—Adds a two second delay to prevent missing transmissions when "calls" and "answers" are on the same frequency.
- **Automatic Lock-Out**—Locks out channels and "skips" frequencies not of current interest.
- **Simple Programming**—Simply punch in on the keyboard the frequency you wish to monitor.
- **Space Age Circuitry**—Custom integrated circuits . . . a *Bearcat* tradition.
- **UL Listed/FCC Certified**—Assures quality design and manufacture.
- **Rolling Zeros**—This *Bearcat* exclusive tells you which channels your scanner is monitoring.
- **Tone By-Pass**—Scanning is not interrupted by mobile telephone tone signal.
- **Manual Scan Control**—Scan all 10 channels at your own pace.
- **3-Inch Speaker**—Front mounted speaker for more sound with less distortion.
- **Squelch**—Allows user to effectively block out unwanted noise.
- **AC/DC**—Operates at home or in the car.

Bearcat® 210 Specifications

Frequency Reception Range

Low Band	32—50 MHz
"Ham" Band	146—148 MHz
High Band	148—174 MHz
UHF Band	450—470 MHz
"T" Band	470—512 MHz

*Also receives UHF from 416—450 MHz

Size
10⅝" W x 3" H x 7⅝" D

Weight
4 lbs. 8 oz.

Power Requirements
117V ac, 11W; 13.8 Vdc, 6W

Audio Output
2W rms

Antenna
Telescoping (supplied)

Sensitivity
0.6μv for 12 dB SINAD on L & H bands
U bands slightly less

Selectivity
Better than −60 dB @ ± 25 KHz

Scan Rate
20 channels per second

Connectors
External antenna and speaker; AC & DC power

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Mounting bracket and hardware
DC cord

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1N4007	1000v	1A	.15
1N4148	75v	10mA	.03
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
1N5243	13v	z	.25
1N5244B	14v	z	.25
1N5245B	15v	z	.25

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18-pin	pcb	.25	ww	.75
22-pin	pcb	.45	ww	1.25
24-pin	pcb	.35	ww	1.25
28-pin	pcb	.35	ww	1.45
40-pin	pcb	.50	ww	1.95

Molex pins .01 To-3 Sockets .25

2 Amp Bridge 100-prv 1.20

25 Amp Bridge 200-prv 1.95

TRANSISTORS, LEDS, etc.

2N2222	NPN			.15
2N2907	PNP			.15
2N3740	PNP	1A	60v	.25
2N3906	PNP			.10
2N3054	NPN			.35
2N3055	NPN	15A	60v	.50
T1P125	PNP	Darlington		.35

LED Green, Red, Clear .15

D.L.747 7 seg 5/8" high com-anode 1.95

XAN72 7 seg com-anode 1.50

FND 359 Red 7 seg com-cathode 1.25

C MOS

4000	.15
4001	.20
4002	.20
4004	3.95
4006	1.20
4007	.35
4008	1.20
4009	.30
4010	.45
4011	.20
4012	.20
4013	.40
4014	1.10
4015	.95
4016	.35
4017	1.10
4018	1.10
4019	.70
4020	.85
4021	1.35
4022	.95
4023	.25
4024	.75
4025	.35
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.95
4034	2.45
4035	1.25
4040	1.35
4041	.69
4042	.95
4043	1.25
4044	.95
4046	1.50
4049	.80
4050	.60
4066	1.35
4069	.40
4071	.35
4082	.45

— T T L —

7400	.15
7401	.15
7402	.20
7403	.20
7404	.15
7405	.25
7406	.35
7407	.55
7408	.25
7409	.15
7410	.10
7411	.25
7412	.30
7413	.45
7414	1.10
7416	.25
7417	.40
7420	.15
7426	.30
7427	.45
7430	.15
7432	.30
7437	.35
7438	.35
7440	.25
7441	1.15
7442	.55
7443	.85
7444	.45
7445	.80
7446	.95
7447	.95
7448	.95
7450	.25
7451	.25
7453	.20
7454	.25
7460	.40
7470	.45
7472	.45

7473	.25
7474	.35
7475	.35
7476	.30
7480	.55
7481	.75
7483	.95
7485	.95
7486	.30
7489	1.35
7490	.55
7491	.95
7492	.95
7493	.40
7494	1.25
7495	.60
7496	.80
74100	1.85
74107	.35
74121	.35
74122	.55
74123	.55
74125	.45
74126	.35
74132	1.35
74141	1.00
74150	1.00
74151	.75
74153	.95
74154	1.05
74156	1.15
74157	.65
74161	.85
74163	.95
74164	.60
74165	1.50
74166	1.35
74175	.80

74176	1.25
74180	.85
74181	2.75
74182	.95
74190	1.75
74191	1.35
74192	1.65
74193	.85
74194	1.25
74195	.95
74196	1.25
74197	1.25
74198	2.35
74221	1.00
74367	.85
75108A	.35
75110	.35
75491	.50
75492	.50
74H00	.25
74H01	.25
74H04	.25
74H05	.25
74H08	.35
74H10	.35
74H11	.25
74H15	.30
74H20	.30
74H21	.25
74H22	.40
74H30	.25
74H40	.25
74H50	.25
74H51	.25
74H52	.15
74H53J	.25
74H55	.25

74H72	.55
74H101	.75
74H103	.75
74H106	.95
74L00	.35
74L02	.35
74L03	.30
74L04	.35
74L10	.35
74L20	.35
74L30	.45
74L47	1.95
74L51	.45
74L55	.65
74L72	.45
74L73	.40
74L74	.45
74L75	.55
74L93	.55
74L123	.55
74S00	.55
74S02	.55
74S03	.40
74S04	.35
74S05	.35
74S08	.35
74S10	.35
74S11	.35
74S20	.35
74S40	.25
74S50	.25
74S51	.45
74S64	.25
74S74	.40
74S112	.90
74S114	1.30

74S133	.45
74S140	.75
74S151	.35
74S153	.35
74S157	.80
74S158	.35
74S194	1.05
74S257(8123)	.25
74LS00	.45
74LS01	.45
74LS02	.45
74LS04	.45
74LS05	.55
74LS08	.45
74LS09	.45
74LS10	.45
74LS11	.45
74LS20	.40
74LS21	.25
74LS22	.25
74LS32	.40
74LS37	.40
74LS40	.55
74LS42	1.75
74LS51	.65
74LS74	.75
74LS86	.75
74LS90	1.30
74LS93	1.00
74LS107	.95
74LS123	1.00
74LS151	.75
74LS153	1.20
74LS157	.85
74LS164	1.90
74LS367	.85
74LS368	.70

9000 SERIES

9301	.85
9309	.35
9322	.85
95H03	.55
9601	.75
9602	.50

MEMORY CLOCKS

74S188 (8223)	3.00
1702A	7.95
MM5314	3.00
MM5316	3.50
2102-1	1.75
2102L-1	1.95
TMS6011NC	6.95
8080AD	15.00
8T13	1.50
8T23	1.50
8T24	2.00
2107B-4	4.95

LINEARS, REGULATORS, etc.

8266	.35
8836	.95
MCT2	.95
8038	3.95
LM201	.75
LM301	.25
LM308 (Mini)	.75
LM309H	.65
LM309K(340K-5)	.85
LM310	1.15
LM311D(Mini)	.75
LM318 (Mini)	.65

LM320K5 (7905)	1.65
LM320K12	1.65
LM320T12	1.25
LM320T15	1.65
LM339	.95
7805 (340T-5)	.95
LM340T-12	1.00
LM340T-15	1.00
LM340T-18	1.00

LM340T-24	.95
LM340K-12	2.15
LM340K-15	1.25
LM340K-18	1.25
LM340K-24	.95
LM373	2.95
LM380	.95
LM709(8,14 PIN)	.25
LM711	.45

LM723	.50
LM725	1.75
LM739	1.50
LM741 8-14	.20
LM747	1.10
LM1307	1.25
LM1458	.95
LM3900	.50
LM75451	.65
NE555	.50
NE556	.95
NE565	.95
NE566	1.75
NE567	1.35
SN72720	1.35
SN72820	1.35

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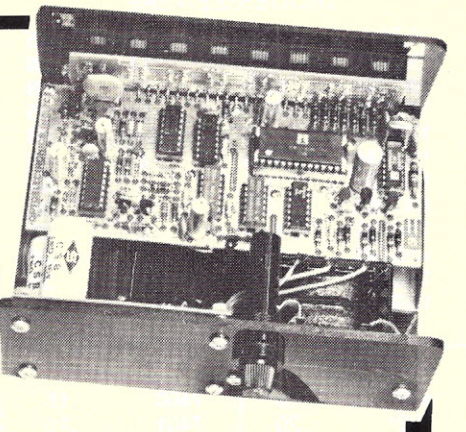
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24 Hour Phone (714) 278-4394 **MasterCharge / BankAmericard**

NEW LSI TECHNOLOGY

FREQUENCY COUNTER

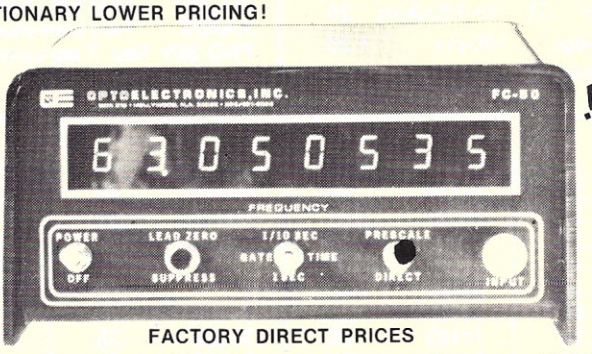
TAKE ADVANTAGE OF THIS NEW STATE-OF-THE-ART COUNTER FEATURING THE MANY BENEFITS OF CUSTOM LSI CIRCUITRY. THIS NEW TECHNOLOGY APPROACH TO INSTRUMENTATION YIELDS ENHANCED PERFORMANCE, SMALLER PHYSICAL SIZE, DRASTICALLY REDUCED POWER CONSUMPTION [PORTABLE BATTERY OPERATION IS NOW PRACTICAL], DEPENDABILITY, EASY ASSEMBLY AND REVOLUTIONARY LOWER PRICING!



.4" DIGITS!

SIZE:
3" High
6" Wide
5½" Deep

1¾ LBS.
COLOR:
BLACK



FACTORY DIRECT PRICES

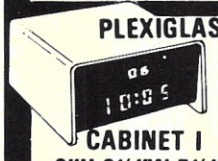
KIT #FC-50C	60 MHZ	COUNTER WITH CABINET & P.S.	$99.85
KIT #PSL-350	350 MHZ	PRESCALER [NOT SHOWN]	23.95
KIT #PSL-650	650 MHZ	PRESCALER [NOT SHOWN]	29.95
MODEL #FC-50WT	60 MHZ	COUNTER WIRED, TESTED & CAL.	165.95
MODEL #FC-50/600 WT	600 MHZ	COUNTER WIRED, TESTED & CAL.	199.95

KIT #FC-50C IS COMPLETE WITH PREDRILLED CHASSIS ALL HARDWARE AND STEP-BY-STEP INSTRUCTIONS. WIRED & TESTED UNITS ARE CALIBRATED AND GUARANTEED. PRESCALERS WILL FIT INSIDE COUNTER CABINET.

FEATURES AND SPECIFICATIONS:

DISPLAY: 8 RED LED DIGITS .4" CHARACTER HEIGHT
GATE TIMES: 1 SECOND AND 1/10 SECOND
[AUTO DEC. PT. PLACEMENT]
RESOLUTION: 1 HZ AT 1 SECOND, 10 HZ AT 1/10 SECOND.
FREQUENCY RANGE: 10 HZ TO 60 MHZ. [65 MHZ TYPICAL].
SENSITIVITY: 10 MV RMS TO 50 MHZ, 20 MV RMS TO 60 MHZ TYP.
INPUT IMPEDANCE: 1 MEGOHM AND 20 PF.
[DIODE PROTECTED INPUT FOR OVER VOLTAGE PROTECTION.]
ACCURACY: ± 1 PPM [± .0001%]: AFTER CALIBRATION TYPICAL.
STABILITY: WITHIN 1 PPM PER HOUR AFTER WARM UP [.001% XTAL]
IC PACKAGE COUNT: 8 [ALL SOCKETED]
INTERNAL POWER SUPPLY: 5.2 V DC AT 800 MA. REGULATED.
INPUT POWER REQUIRED: 8-12 VDC OR 115 VAC AT 50/60 HZ.
POWER CONSUMPTION: 4 WATTS
INPUT CONNECTOR: BNC TYPE

PLEXIGLAS CABINETS



Great for Clocks or any LED Digital project. Clear-Red Chassis serves as Bezel to increase contrast of digital displays.

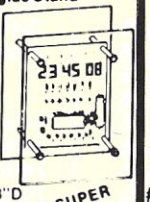
CABINET I
3"H,6¼"W,5½"D

CABINET II
2½"H,5"W,4"D

Black, White or Clear Cover
$6.50 ea.

RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS
3"x6"x1/8" **95¢** ea. **4/$3**

SEE THE WORKS Clock Kit
Clear Plexiglas Stand



- 6Big .4" digits
- 12 or 24 hr. time
- 3 set switches
- Plug transformer
- all parts included

Plexiglas is Pre-cut & drilled
Kit #850-4 CP
Size: 6"H,4½"W,3"D

$23.50 ea. **2/$45.** A SUPER CLOCK!

60 HZ.
XTAL TIME BASE

Will enable Digital Clock Kits or Clock-Calendar Kits to operate from 12V DC. 1"x2" PC Board
Power Req: 5-15V (2.5 MA. TYP.)
Easy 3 wire hookup
Accuracy: ± 2PPM
#TB-1 (Adjustable)
Complete Kit **$4.95**
Wir & Cal $9.95

SPECIAL PRICING!
PRIME - HIGH SPEED RAM

21L02-3 400 NS

LOW POWER - FACTORY FRESH

1-24	$1.95 ea	100-199	$1.60 ea
25-99	1.75 ea	200-499	1.45 ea

OVER 500 PCS. **$1.39** ea.

6-DIGIT LED CLOCK CALENDAR KIT
DATE-TIME-SNOOZE ALARM & MORE... KIT 7001

FOR THE BUILDER THAT WANTS THE BEST. FEATURING 12 OR 24 HOUR TIME — 29-30-31 DAY CALENDAR. ALARM, SNOOZE AND AUX. TIMER CIRCUITS

Will alternate time (8 seconds) and date (2 seconds) or may be wired for time or date display only, with other functions on demand. Has built-in oscillator for battery back-up. A loud 24 hour alarm with a repeatable 10 minute snooze alarm, alarm set & timer set indicators. Includes 110 VAC/60Hz power pack with cord and top quality components through-out.

KIT - 7001B WITH 6 - .5" DIGITS $39.95
KIT - 7001C WITH 4 - .6" DIGITS & 2 - .3" DIGITS FOR SECONDS $42.95
KIT - 7001X WITH 6 - .6" DIGITS $45.95



KITS ARE COMPLETE (**LESS CABINET**)
ALL 7001 KITS FIT CABINET I AND ACCEPT QUARTZ CRYSTAL TIME BASE KIT # TB-1

JUMBO DIGIT CLOCK

A complete Kit (less Cabinet) featuring: six .5" digits, MM5314 IC 12/24 Hr. time, PC Boards, Transformer, Line Cord, Switches and all Parts. Ideal Fit in Cabinet II

Kit #5314-5 **$19.95** **2/$38.**

JUMBO DIGIT CONVERSTION KIT **$9.95** ea.

Convert small digit LED clock to large .5" displays. Kit includes 6 - LED's, Multiplex PC Board & Hook up info.

Kit #JD-1CC For Common Cathode
Kit #JD-1CA For Common Anode

PRINTED CIRCUIT BOARDS for CT-7001 Kits sold separately with assembly info. PC Boards are drilled Fiberglass, solder plated and screened with component layout.

Specify for 7001
B, C or X - $7.95

AUTO BURGLAR ALARM KIT



AN EASY TO ASSEMBLE AND EASY TO INSTALL ALARM PROVIDING MANY FEATURES NOT NORMALLY FOUND. KEYLESS ALARM HAS PROVISION FOR POS & GROUNDING SWITCHES OR SENSORS. WILL PULSE HORN RELAY AT 1HZ RATE OR DRIVE SIREN. KIT PROVIDES PROGRAMMABLE TIME DELAYS FOR EXIT, ENTRY & ALARM PERIOD. UNIT MOUNTS UNDER DASH - REMOTE SWITCH CAN BE MOUNTED WHERE DESIRED. CMOS RELIABILITY. RESISTS FALSE ALARMS & PROVIDES FOR ULTRA DEPENDABLE ALARM. DO NOT BE FOOLED BY LOW PRICES! THIS IS A TOP QUALITY COMPLETE KIT WITH ALL PARTS INCLUDING DETAILED DRAWINGS AND INSTRUCTIONS OR AVAILABLE WIRED AND TESTED

KIT #ALR-1 $9.95
#ALR-1WT WIRED & TESTED $19.95

VARIABLE REGULATED 1 AMP POWER SUPPLY KIT

- VARIABLE FROM 4 to 14V
- SHORT CIRCUIT PROOF
- 723 IC REGULATOR
- 2N3055 PASS TRANSISTOR
- CURRENT LIMITING AT 1 Amp

KIT IS COMPLETE INCLUDING DRILLED & SOLDER PLATED FIBERGLASS PC BOARD AND ALL PARTS (Less TRANSFORMER) **KIT #PS-01 $8.95**

TRANSFORMER 24V CT will provide 300MA at 12V and 1 Amp at 5V. **$3.50**

MOBILE LED CLOCK

12/24 HR .4" DIGITS!



MODEL #2001 — **12 VOLT AC or DC POWERED**

- 6 JUMBO .4" RED LED'S BEHIND RED FILTER LENS WITH CHROME RIM
- SET TIME FROM FRONT VIA HIDDEN SWITCHES • 12/24-Hr. TIME FORMAT
- STYLISH CHARCOAL GRAY CASE OF MOLDED HIGH TEMP. PLASTIC
- BRIDGE POWER INPUT CIRCUITRY — TWO WIRE NO POLARITY HOOK-UP
- OPTIONAL CONNECTION TO BLANK DISPLAY [Use When Key Off in Car, Etc.]
- TOP QUALITY PC BOARDS & COMPONENTS - INSTRUCTIONS.
- MOUNTING BRACKET INCLUDED

KIT #2001 COMPLETE KIT [Less 9V. Battery] **$29.95** EA. 3 OR MORE **$27.95** EA. 115 VAC Power Pack #AC-1 **$2.50** EA.

ASSEMBLED UNITS WIRED & TESTED ORDER #2001 WT [LESS 9V. BATTERY] Wired for 12-Hr. Op. if not otherwise specified. **$39.95** EA. 3 OR MORE **$37.95** EA.

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WE PAY ALL SHIPPING IN CONTINENTAL USA — OTHERS ADD 5% [10% FOR AIRMAIL]

CRYSTALS

THESE FREQUENCIES ONLY

Part #	Frequency	Case/Style	Price
CY1A	1.000 MHz	HC33/U	$5.95
CY2A	2.000 MHz	HC33/U	$5.95
CY2.01	2.010 MHz	HC33/U	$1.95
CY3A	4.000 MHz	HC18/U	$4.95
CY7A	5.000 MHz	HC18/U	$4.95
CY12A	10.000 MHz	HC18/U	$4.95
CY14A	14.31818 MHz	HC18/U	$4.95
CY19A	18.000 MHz	HC18/U	$4.95
CY22A	20.000 MHz	HC18/U	$4.95
CY30B	32.000 MHz	HC18/U	$4.95

EXAR

XR-2206KB Kit $29.95 **Special** **XR-2206KA Kit $19.95**

WAVEFORM GENERATORS

XR-205	$8.40
XR-2206CP	4.49
XR-2207CP	3.85

STEREO DECODERS

XR-1310CP	$3.20
XR-1310EP	3.20
XR-1800P	3.20
XR-2567	2.99

MISCELLANEOUS

XR-2211CP	$6.70
XR-4136	.99
XR-1468	3.85
XR-1488	5.80
XR-1489	4.80
XR-2208	5.20

TIMERS

XR-555CP	$ .39
XR-320P	1.55
XR-556CP	1.85
XR-2556CP	3.20
XR-2240CP	3.25

PHASE LOCKED LOOPS

XR-210	5.20
XR-215	6.60
XR-567CP	1.95
XR-567CT	1.70

CONNECTORS

PRINTED CIRCUIT EDGE-CARD

.156 Spacing-Tin-Double Read-Out

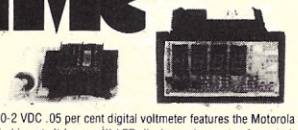
Bifurcated Contacts — Fits .054 to .070 P.C. Cards

15/30	PINS (Solder Eyelet)	$1.95
18/36	PINS (Solder Eyelet)	$2.49
22/44	PINS (Solder Eyelet)	$2.95
50/100	PINS (Wire Wrap)	$6.95
50/100A (.100 Spacing)	PINS (Wire Wrap)	$6.95

25 PIN-D SUBMINATURE

DB25P	PLUG	$3.25
DB25S	SOCKET	$4.95

iMC 3½ DIGIT DVM KIT



This 0-2 VDC .05 per cent digital voltmeter features the Motorola 3½ digit DVM chip set. It has a .4" LED display and operates from a single +5V power supply. The unit is provided complete with an injection molded black plastic case complete with Bezel. An optional power supply is available which fits into the same case as the 0-2V DVM allowing 117 VAC operation.

A. 0-2V DVM with Case $49.95

B. 5V Power Supply $14.95

Etching Kits

32 X A-1	P.C. Etch Materials Kit enough for 5 circuit boards	$29.95 ea.
27 X A-1	Etched Circuit Kit	$ 9.95 ea.
Plugboards	Complete kit — only add water	
3662	6.5 X 4.5 X 1/16 Epoxy glass P-Pattern-44 P.C. Tabs-spaced .156"	$ 6.95 ea.
22/44	Mating connector for plugboard — 22 pin double readout	$ 2.95 ea.
8800V	Universal Microcomputer/Processor plugboard — Epoxy Glass — complete with heatsink and mounting hardware 5.313 X 10 X 1/16 copper clad	$19.95 ea.

Vector

1/16 VECTOR BOARD

	0.1" Hole Spacing Part No.	P-Pattern L	P-Pattern W	Price 1	Price 2-Up
PHENOLIC	64P44 062XXXP	4.50	6.50	1.72	1.54
	169P44 02XXXP	4.50	17.00	3.69	3.32
EPOXY GLASS	64P44 062	4.50	6.50	2.07	1.86
	84P44 062	4.50	8.50	2.56	2.31
	169P44 062	4.50	17.00	5.04	4.53
	169P84 062	8.50	17.00	9.23	8.26
EPOXY GLASS COPPER CLAD	169P44 062C1	4.50	17.00	6.80	6.12

Vector

SLIT-N-WRAP WIRE WRAP TOOL

- Slits and opens insulation exposing bare wire
- No pre-cutting or pre-stripping.
- Comes complete with two - 100 ft spools #28 AWG wire

Model P180 $24.50

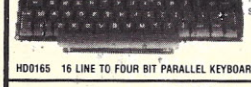
HEXADECIMAL ENCODER 19-KEY PAD



- 1 - 0
- ABCDEF
- Return Key
- Optional Key (Period)
- — Key

$10.95 each

63 KEY KEYBOARD



This keyboard features 63 unencoded SPST keys, unattached to any kind of P.C.B. A very solid molded plastic 13" x 4" base suits most applications.

$24.95

HD0165 16 LINE TO FOUR BIT PARALLEL KEYBOARD ENCODER $7.95

TOOLS

A97MS	— Diagonal Cutter - 4" semi-flush cut	$8.50 ea.
A11DMS	— Chain Nose Pliers - 4¾" long	7.50 ea.
T-6	— Wire Stripper - #16 to #26 gauge	3.75 ea.
55B	— Wire Stripper - #10 to #20 gauge	2.50 ea.
CS-8	— Cutter-Crimper Tool - 8¼" long	8.50 ea.
	Nippling Tool — Cuts, Trims or Notches Metal up to #18 gauge	6.95 ea.
	Nibbling Tool Replacement Punch	3.75 ea.

PERMACEL® P-29 PLUS Electrical Tape - All Weather

• ¾" wide x 66 ft. • Black Vinyl

1-9 Rolls **$.79 each** 10-up Rolls **$6.95/10 roll package**

MICROPROCESSOR COMPONENTS

8080A	CPU	$19.95	8228	System Controller - Bus Driver	$10.95
8212	8 Bit Input/Output	4.95	MC6800L	8 Bit MPU	35.00
8214	Priority Interrupt Control	15.95	MC6820L	Periph. Interface Adapter	15.00
8216	Bi-Directional Bus Driver	6.95	MC6810AP1	128 x 8 Static RAM	6.00
8224	Clock Generator/Driver	10.95	MC6830L8	1024 x 8 Bit ROM	18.00
CDP1802	- with user manual	39.95	Z80	CPU	49.95

CPU'S

8080	Super 8008	24.95
8080A	Super 8008	19.95
2650	8 BIT MPU	26.50

SR'S

2504	1024 Dynamic	$ 3.95
2518	Hex 32 BIT	7.00
2519	Hex 40 BIT	4.00
2524	512 Dynamic	2.49
2525	1024 Dynamic	6.00
2527	Dual 256 BIT	3.95
2529	Dual 512 BIT	4.00
2532	Quad 80 BIT	3.95
2533	1024 Static	Special 5.95
3341	Fifo	6.95
74LS670	16 x 4 Reg	3.95

UART'S

AY-5-1013	30K Baud	$5.95

ROM'S

2513(2140)	Char. Gen.-upper case	$ 9.95
2513(3021)	Char. Gen.-lower case	9.95
2516	Char. Gen.	10.95

RAM'S

1101	256 x 1	Static	$ 1.49
2101	256 x 4	Static	5.95
2102	1024 x 1	Static	1.75
2107/5280	4096 x 1	Dynamic	4.95
2111	256 x 4	Static	6.95
7489	16 x 4	Static	2.49
8101	256 x 4	Static	6.95
8111	256 x 4	Static	6.95
8599	16 x 4	Static	3.49
91L02	1024 x 1	Static	2.25
74200	256 x 1	Static	6.95
93421	256 x 1	Static	2.95
MM5262	2K x 1	Dynamic	2 for 1.00

PROMS

1702A	2048	Famos	$ 9.95
5203	2048	Famos	14.95
82S23	32 x 8	Open C	5.00
82S123	32 x 8	Tristate	5.00
74S287	1024	Static	7.95
3601	256 x 4	Fast	3.95
2708	8K	Eprom	29.95
6301-1	1024	Tri-State Bipolar	3.49
6330-1	256	Open Collector Bipolar	2.95
6331-1	256	Tri-State Bipolar	2.95

SPECIAL REQUESTED ITEMS

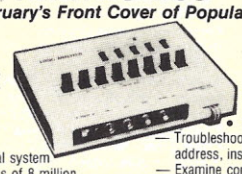
FCM3817	$ 5.00					8T97	2.00
AY-3-8500-1	$16.95						
MC3061P	3.50	CD4508	6.75	82S115	25.00	3341	6.95
MC4016P (74416)	7.50	CD4515	6.50	5841	9.95	9368	3.95
MC14583	3.50	CD4520	2.70	MK50240	17.50	MC1408L7	9.95
MC14562	14.50	MCM6571	17.50	11C90	19.95	LD110/LD111	25.00/set
CD4059	9.95	MCM6574	17.50	DS0026CH	3.75	AY-5-9100	17.50 ea.
CD4070	.95	MCM6575	17.50	TIL308	10.50	95H90	13.95
MC14409	14.95	MC14419	14.95	ICM7208	22.00	ICM7209	7.50
MC14410	14.95	ICM7045	24.95	ICM7207	7.50	HD0165	7.95

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Logic Analyzer Kit



MODEL 100A

$189.00/Kit

- Analyzes any type of digital system
- Checks data rates in excess of 8 million words per second
- Trouble shoot TTL, CMOS, DTL, RTL, Schottky and MOS families
- Displays 16 logic states up to 8 digits wide
- See ones and zeros displayed on your CRT, octal or hexadecimal format
- Tests circuits under actual operating conditions
- Easy to assemble — comes with step-by-step construction manual which includes 80 pages on logic analyzer operation.

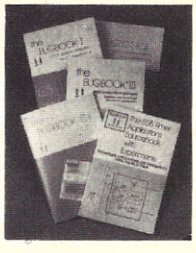
• Some applications are:

— Troubleshooting microprocessor address, instruction, and data flow
— Examine contents of ROMS
— Tracing operation of control logic
— Checking counter and shift register operation
— Monitoring I/O sequences
— Verifying proper system operations during testing

TRIGGER EXPANDER — Model 10
Adds 16 additional Bits — Connects direct to Model 100A (Optional baseplate permits mounting to 100A for integrated unit) (Baseplate — $12.00) **Model 10 — $229.00**

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(6" long X 4" wide)



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PB102 - 7" x 4.5"	39.95
PB103 - 9" x 6"	59.95
PB104 - 9.5" x 8"	79.95
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PB203A - 9.75 x 6½ x 2¾ (includes power supply)	120.00

PROTO CLIPS

14 PIN	$4.50
16 PIN	4.75
24 PIN	8.50

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DM1 - Circuit Designer 54.95

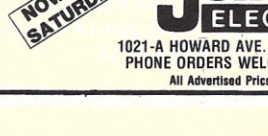
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DM3 - RC Bridge 59.95

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Logic Monitor $84.95 for DTL, HTL, TTL or CMOS Devices

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QT-59B	bus strip	2.50
QT-47S	470	10.00
QT-47B	bus strip	2.25
QT-35S	350	8.50
QT-35B	bus strip	2.00
QT-18S	180	4.75
QT-12S	120	3.75
QT-8S	80	3.25
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Timeband by FAIRCHILD LAMP CLOCK



- 24 hour alarm
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Model C-590 (Ivory) $29.95

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SEVEN DIFFERENT INSTRUMENTS!

MEETS OR EXCEEDS ORIGINAL AUTOMOTIVE SPECS.

*Please specify which **one** of the seven models you want when ordering – these **do not** all come in one unit. Each model must be bought separately.*

1 TACHOMETER 0-9900 RPM 4, 6 or 8 Cylinders

2 WATER TEMP. 100-250° F

3 FUEL LEVEL Percentage Low Fuel Indicator



4 SPEEDOMETER* 0-99 MPH

5 OIL PRESSURE 0-80 PSI

6 OIL TEMP 200-350° F

7 BATTERY MONITOR ±1 Volts From 11-15 VDC

BRIGHT YELLOW ORANGE .3" LED DISPLAY!

Kit includes case, bracket and all components — complete. Nothing else to buy! 12 Volt NEG GRD.

DIMENSIONS: 4½ x 4 x 2

KIT: $49.95

* Add $10.00 for required speed transducer. ASSEMBLED: $59.95

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- Bright 6 Digit LED Display
- Times to 59 minutes 59.59 seconds
- Crystal Controlled Time Base
- Three Stopwatches in One Times Single Event — Split & Taylor
- Size 4.5" x 2.15" x .90" (4½ ounces)
- Uses 3 Penlite Cells.

Kit — $39.95

Assembled — $49.95

Heavy Duty Carry Case $5.95

Stop Watch Chip Only (7205) $19.95

QUARTZ DIGITAL AUTO CLOCK OR ELAPSED TIMER!

Elapsed Timer: Hrs, Mins and Secs
12 or 24 Hr Capacity
Simple Reset - Start Pushbutton Control



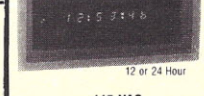
Complete kit includes mounting bracket, case and all components, nothing else to buy. Features MM5314 chip: Large .4" LED's. Accuracy better than ± min. per mo. internal battery backup. 12 volt non-polar operation.

DIMENSIONS 4½" x 4" x 2"
12 or 24 HOUR MODE

Kit: $29.95
Assembled: $39.95

CASE ONLY (includes hardware, mounting bracket and bezel) **$6.50**

JE700 CLOCK



12 or 24 Hour

115 VAC

The JE700 is a low cost digital clock, but is a very high quality unit. The unit features a simulated walnut case with dimensions of 6" x 2½" x 1". It utilizes a MAN72 high brightness readout, and the MM5314 clock chip.

$17.95



DIGITAL CLOCK KIT — 3½ INCH DIGITS

4 DIGIT KIT $49.95 **4 DIGIT ASSEMBLED $59.95**

6 DIGIT KIT $69.95 **6 DIGIT ASSEMBLED $79.95**

This clock features big 3½" high digits for viewing in offices, auditoriums, etc. Each digit is formed by 31 bright 0.2" LED's. The clock operates from 117 VAC, has either 12 or 24 hr. operation. The 6 digit version is 27" x 3½" x 1½" and the 4 digit is 18" x 3½" x 1½". Kits come complete with all components, case and transformer.

Specify 12 or 24 Hour When Ordering

JE803 PROBE



The Logic Probe is a unit which is for the most part indespensible in trouble shooting logic families TTL, DTL, RTL, CMOS. It derives the power it needs to operate directly off of the circuit under test, drawing a scant 10 mA max. It uses a MAN3 readout to indicate any of the following states by these symbols (H) - 1 (LOW) - 0 (PULSE) - P. The Probe can detect high frequency pulses to 45 MHz. It can't be used at MOS levels or circuit damage will result.

$9.95 Per Kit

printed circuit board

T²L 5V 1A Supply

This is a standard TTL power supply using the well known LM309K regulator IC to provide a solid 1 AMP of current at 5 volts. We try to make things easy for you by providing everything you need in one package, including the hardware for only.

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PROM'S

1702A	256 x 8 Bit 1 us TS Erasable	5.00
1702AL	256 x 8 Bit 1 us TS Eras Lo Pwr	7.00
2704	512 x 8 Bit 450 ns TS Erasable	20.00
2708	1024 x 8 Bit 450 ns TS Erasable	27.08
3601	256 x 4 OC 70 ns	4.50
5203AQ	256 x 8 Bit 1 us TS Erasable	7.00
5204AQ	512 x 8 Bit 1 us TS Erasable	10.00
82S23B	32 x 8 Bit 50 ns OC	4.00
82S129B	256 x 4 Bit 50 ns TS	4.25
8223B	32 x 8 Bit 50 ns OC	4.00

WAVEFORM GENERATOR

8038	VCO	4.50
MC4024	Dual VCO	2.75
566	VCO-Function	2.00

CHARACTER GENERATORS

2513	5x7 5 line Lower Case	6.75
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MCM6571	128 x 9 x 7 ASCII Shifted Greek	10.80
MCM6571A	128 x 9 x 7 Downcount	10.80
MC6572	128 x 9 x 7 ASCII Non-Shifted W/G	10.80

SHIFT REGISTERS

	DYNAMIC	
1404AN	1024 x 1 Bit 2.5 MHz	3.00
2505K	512 x 1 Bit 2.5 MHz	3.00

	STATIC	
MM506	100 x 2 Bit	.89
2509K	50 x 2 Bit 1.5 MHz	1.00
2518B	32 x 6 Bit 2.0 MHz	3.95
2533V	1024 x 1 Bit 1.5 MHz	2.00
TMS3002	50 x 2 Bit 1.0 MHz	1.00
TMS3112	32 x 6 Bit 2.0 MHz	3.95
MM5058	1024 x 6 Bit 1.5 MHz (8 pin)	2.00

MISC OTHER COMPONENTS

NH0025CN	Dual Low Cost MOS Clock Driver	1.75
NH0026CN	5 MHz Dual Mos Clock Driver	3.00
N8T20	Bi-Directional One Shot	4.00
N8T26	Quad Bus Driver/Receiver	3.25
N8T97	Tri State Hex Buffer	1.45
DM8098	Tri State Hex Inverter	1.00
1488	RS232 Quad Line Driver	1.95
3205	1-of-8 Decoder 18 ns Delay	6.20
D-3207A	Quad NAND to MOS Driver	2.50
C-3404	6 Bit Latch 12 ns O/P Delary	3.95
P-3408A	Tri State Hex MOS Sense Amp	6.75
P-4201	Clock Generator	4.95
MM-5320	T V Camera Sync Generator	6.00
MM-5369	Oscillator Pre-Scaler	2.00
DM-8130	Ten Bit Comparator	2.25
DM-8131	6 Bit Comparator	2.35
DM-8831	4 Input AND NAND Tri State	2.50
DM-8833	Quad Tri State Transceiver (True)	2.50
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U A R T S

AY5-1013	(GI)	6.95
TR-1602A	(WD)	6.95
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8080A	Super 8008	16.95
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F8	CPU (3850)	19.95
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1103	1024 x 1 Bit 300 ns	1.50
2107B	4096 x 1 Bit 200 ns	4.50
2107B-4	4096 x 1 Bit 270 ns	4.00
4050NL	4096 x 1 Bit 300 ns	4.50
4096	4096 x 1 Bit 300 ns	5.00
MM5262	2048 x 1 Bit 365 ns	3.00
MM5270	4096 x 1 Bit 200 ns (18 Pin)	5.00
5280	4096 x 1 Bit 200 ns (16 Pin)	6.00

STATIC RAMS

21L02-1	1024 x 1 Bit 350 ns TS	1.58
31L01	16 x 4 Bit 110 ns OC	2.00
1101A	256 x 1 Bit 1 us TS	1.00
2101	256 x 4 Bit 1 us TS	3.00
2102	1024 x 1 Bit 1 us TS	1.25
2102-1	1024 x 1 Bit 500 ns TS	1.50
2111A-4	256 x 4 Bit 450 ns TS (18 pin)	4.45
2112A-4	256 x 4 Bit 450 ns TS (16 pin)	3.00
2501B	256 x 1 Bit 1 us	1.45
3107	256 x 1 Bit 80 ns OC	2.95
4200A	4096 x 1 Bit 250 ns	13.75
74C89	16 x 4 Bit 280 ns TS	3.00
74S201	256 x 1 Bit 50 ns TS	4.75
91L02A	1024 x 1 Bit 500 ns TS	2.00
7489	16 x 4 Bit 60 ns OC	2.25
8225	16 x 4 Bit 50 ns OC	1.50
8599	15 x 4 Bit 50 ns TS	1.50
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FIFO

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2708 E-PROM Price $27.08 ea.

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FEATURES

- Plug compatible with the ALTAIR 8800 and IMSAI 8080, or any other system using the "ALTAIR bus."
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- Low-power Schottky support chips.
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16	Wire Wrap Tin	.30
18	Lo Pro Tin	.25
18	Wire Wrap Tin	.85
20	Wire Wrap Tin	.95
22	Lo Pro Open Frame Tin	.50
22	Wire Wrap Tin	.95
24	Standard P C Tin	.50
24	Wire Wrap Tin	.85
24	Lo Pro (Open Frame) Tin	.40
28	Lo Pro (Open Frame) Tin	.40
28	Standard P C Tin	.60
28	Wire Wrap Tin	.95
40	Lo Pro (Open Frame) Tin	.50
40	Wire Wrap Tin	1.65

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GREATER FREQUENCY RANGE the 60 mHz typical frequency response gives you 80-10 meters plus 6 meters — 50mHz guaranteed.

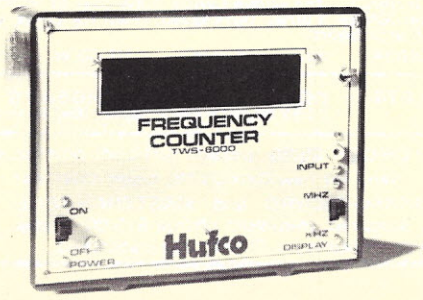
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With the overload protected front end you can use this counter anywhere in a circuit without fear of burnout. Use the Mark II to test: receiver local oscillators, grid dip meters, RF signal generators, audio generators, touch tone pads (when extend installed), micro-processor timing signals, modems, function generators . . . YOU NAME IT!!!

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H-10

SUPER ASCII KEYBOARD



We have had many excellent keyboards in the past, so we have to call this one "SUPER". Besides the regular keyboard characters, there are 10 control positions, a separate numeric pad, and a 5 key cursor control. We supply the necessary data. Total of 89 keys.

STOCK NO.5523K ASCII Keyboard (LIMITED QUANTITY) $48.50 2/95.00

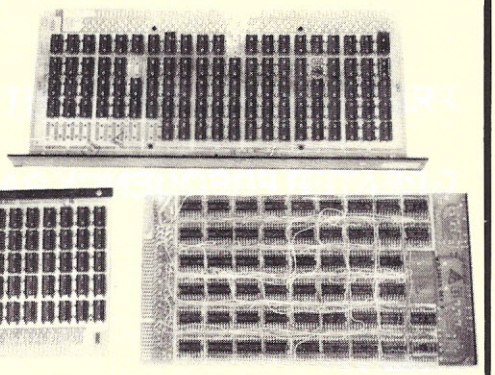
VIDEOCUBE TV INTERFACE KIT

This is the TV interface device, described in the August issue of RADIO-ELECTRONICS. The VIDEOCUBE will interface video cameras, TV games, or the video output of mini and micro computers, to your TV set. FCC approved. Consists of a modulator and oscillator, which put the information on channel 2 of your TV set. We supply a reprint of the RADIO-ELECTRONICS article, and all necessary data. Kits come complete, with all parts, and partial with all hard to get parts, such as balan, coils, special feed thru caps, transistor, shield etc.

STOCK NO.5500 K, complete kit with data $13.95 2/26.00

STOCK NO.5500RK, Partial kit, with data. $11.95 2/22.00

WIRE WRAP PROTOTYPE BOARDS



Wire wrap boards for prototyping are expensive, running from $25.00 for small boards, up to almost $300.00 for the larger boards. They are ideal for prototyping, or making devices when a PC board is not practical. We have 3 boards, which came out of equipment, so the previous wiring must be removed. Using a wire wrap-unwrap tool, such as the OK tool, or VECTOR, this does not take long. Board 1 has from 75 to 100 sockets with mostlt 14 pin sockets, some 16 pin sockets, and provision for adding 16 pin sockets if required. Board 2 has from 42 to 50 sockets, with provision for extra 16 pin sockets if needed. Board 3 has from 45 to 50 sockets, with the wire wrap pins brought out to the top of the board, so that all work can be done on the top of the board.

STOCK NO.6558K	75 to 100 sockets	$18.75 2/35.00
STOCK NO.6559K	42 to 50 sockets	$11.75 2/22.00
STOCK NO.6572K	45 to 50 sockets wire wrap pins on top	$12.75 2/24.00

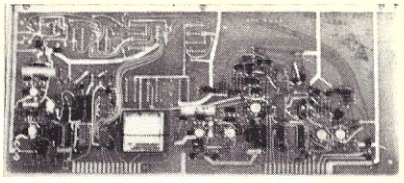
REGULATED 5 VOLT & ± 12 VOLT SUPPLIES

We have 2 very high quality regulated power supplies. Supply 1 is rated 5 volts @ 8 amps. is very highly regulated. .006%. This supply requires a 48 volt AC input, so we supply a 48 volt transformer with the supply.
Supply 2 is a 5 Volt, 6 amp., and ±12 volts @ 2 amps. also ±6 volts @ 100 ma. These supplies have been removed from CODEX equipment, and are tested and guaranteed.

STOCK NO.5514K 5 volt 8 amp supply $23.50 ea. 2/45.00

STOCK NO. 5519K 5 volt 6 amp. & 12 volt & 6 volts $27.50 ea. 2/50.00

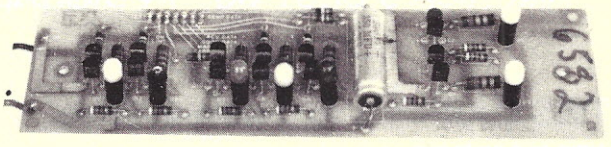
CRYSTAL OSCILLATOR BOARDS



This board was used as the timing board on a CODEX Modem. It has a VECTRON CO-231T crystal oscillator, with tunibg option for accuracy of .0001%. Crystal freq. is 4.9152 Mhz, which divides conveniently to many frequencies including 100 Hz, 60 Hz, 50 Hz and 1 Hz. We provide data showing how to get these frequencies. VECTRONS current price for this oscillator is $85.00. The board also contains many op amps, transistors, tantalum caps, series 7400 ICs, and much more. More than enough to make your own timing board or clock with a precision crystal oscillator.

STOCK NO.6560K Crystal Oscillator board $16.95 2/32.00

INDICATOR BOARD



This small board, 6½"x2" was used as an indicator board. It contains 7 miniature grain of wheat lamps, 5 volts @ 80 ma., sockets for these lamps, and plastic lenses of various colors that fit over the lamp to give a colored indication. The board also contains 14 2n3904 transistorsused as drivers for the above lamps. New cost of lamp and socket was over .85 each when purchased. Ideal for parts, or as your own indicator board.

STOCK NO.6582K Indicator board $1.50 ea. 4/5.00

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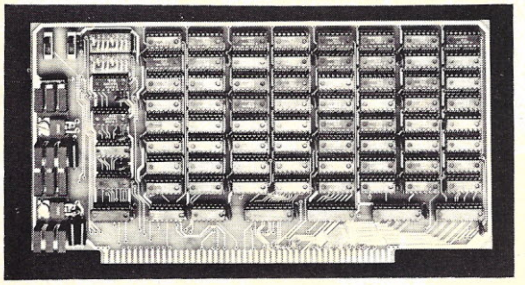
the GODBOUT GAZETTE

Bill Godbout Electronics
PO Box 2355 Oakland CA 94614

CREDIT CARD ORDERS / 24 HOUR ORDER DESK: Place BankAmericard®/Mastercharge®/Visa® charge card orders ($15 minimum) by calling (415) 562-0636, 24 hours. By the way, do you have our flyer? You probably should.

GODBOUT'S INTRODUCES 24K OF MEMORY FOR $450; HOBBYISTS REJOICE!

INCLUDES STATIC DESIGN, TRI-STATE OUTPUTS, S100 BUSS COMPATIBILITY



EXCLUSIVE TO THE GAZETTE

It is now possible to purchase three 8K Econoram II™ boards for $450. A single 8K board, the fastest selling computer kit in Godbout's history, is still available for $163.84.

"We wanted to make it possible for the computer hobbyists to stuff a lot of memory into their machines at a reasonable price", Bill Godbout is quoted as saying today. Judging from the response, he seems to have succeeded.

However, a representative for the company stressed that price was not the only attractive feature of this board, citing the low current consumption (1.5A guaranteed, 1250 mA typical) and high speed (0 wait states). For users of Z-80 processors driven by a 4 Mhz clock, there is even on-board logic for implementing 1 wait state.

He added, "the vector interrupt feature, which lets you know if you are trying to write into protected memory, is very handy. Also, the board was designed to be configured as two, separately addressable 4K blocks which adds considerably to the versatility."

A poll of users, undertaken by Godbout's, shows that hobbyists are pleased by the all-static design, which eliminates dynamic timing problems. Others find the tri-state outputs, and fully buffered inputs and outputs, to be their favorite features. All agree that the quality is exceptional, from the legended and solder masked board to the low profile sockets.

Those wishing to take advantage of the special 3/$450 offer should ask for #SPC-24. The standard 8K board ($163.84) is stock number CK-008; an assembled version, #CK-010, is available for $188.50. A 4K version of the board costs $100 in kit form (#CK-007) and $120 assembled (#CK-009).

Energy Crisis Hits Home

Computer owners from coast to coast have complained of a lack of available energy for their computers. The problem lies not with power generating stations, but rather with the shortage of compact, low priced power supplies capable of providing the many voltages required by microprocessing systems. Experimenters also report being frustrated by the lack of power supplies.

However, the Gazette has confirmed existence of a solution to this energy crisis. Our highly placed source, nicknamed "deep volt", has leaked the following information about a "CPU Power Supply", also known by its stock number (#CK-014).

"The unit appears to be a well thought out supply, which delivers 5V @ 4A with crowbar overvoltage protection, along with ½ Amp of +12V and ½ Amp of -12V. A particularly sneaky feature is an adjustable 10 mA bias supply, required by some CPUs, that is often not included in other units. **Those who say there are no economical power supplies for small systems are in for a shock as the price is a mere $50.**

"Despite rumors of a power supply energy crisis, with wildly inflated prices forced on a public with no other choice, it seems that the Godbout CPU Power Supply should lay these misconceptions to rest permanently."

MOTHERS SAFE FROM BUSS POLLUTION

Many motherboards have reported flu-like symptoms (coughing, sneezing, dropping bits, scrambling data) when loaded with more than a few peripheral boards. It seemed that these motherboards lacked antibodies capable of rejecting noise, crosstalk, overshoot, etc. This is commonly called "buss pollution".

However, it was discovered that a particular group of motherboards, located in the wilds of the Oakland Airport, had developed an immunity to buss pollution.

It seemed these motherboards had active termination circuitry, and that's what accounted for the difference. Old motherboards may be immunized by simply plugging in an **Active Terminator Network** (#CK-017, **$29.50**).

Or, if you want a new motherboard, Godbout's has two --- both with active terminations, lots of bypass caps, and heavy PC board traces:

#CK-015, a **10/11 Slot Motherboard**, comes with 10 edge connectors and is excellent for adding on to small systems. **$90.00**

#CK-016, an **18 Slot Motherboard**, includes 18 edge connectors and is ideal for starting a stand-alone system. **$124.00**

Processor Prices Plummet

The workhorse 8080A, darling of the chip'set, has reached a new low in pricing. Prime, new full spec units cost only **$12.95** regardless of quantity purchased when you order part #SPC-22.

In a parallel development memory prices continue to drop. Full speed 2708s are now available for **$25.00**; order part #SPC-23.

COMPUTER STRIKE AVERTED

Things looked tough at the negotiating tables located at computer stores throughout the country. The heart of the problem was a common computer grievance: having to shuttle programs in and out of their RAMs, thus hampering their productivity, and tying up work for hours at a time. Computers also complained of abuse at the hands of owners, who became enraged when programs went down the drain if the power went off for even a split second.

When the Godbout team of negotiators arrived on the scene, the computers showed a new spirit of compromise. After all, many of them had Godbout memories inside their cases---and computers are known for their loyalty.

The solution: the computers would go on working, if the owners plugged Godbout Econorom II™ boards into their systems. Then, they would't have to worry about losing their minds if the power went away, because Econoroms hold programs and routines in eraseable read only memory. So that owners wouldn't face undue hardship due to the extra expense Godbout's introduced several different boards, of various price levels and complexities. All of them feature 1K of static RAM as part of the memory; all of them are compatible with the S-100 buss used by Altair, IMSAI, and many others. They can be programmed by the Godbout Programming Service, or may be shipped unprogrammed.

Many computers, however, specifically suggested the 8080 software board. This 4K Econorom II is programmed with editor and assembler routines for the 8080, very much like the old Econorom; but this newer version has improved listings, which are a natural for getting any 8080 system up and running. For the benefit of any computers who did not receive word of the strike settlement, listed below are the boards offered by Godbout's:

#CK-002 (Smaller) Econorom II™: 2K X 8 of EROM.....**$195.00**

#CK-003 (Basic) Econorom II™; 4K X 8.....**$250.00**

#CK-004 (Bigger) Econorom II™; 8K X 8, configured as two separate 4K blocks.....**$350.00**

#CK-005 8080 Software Board A valuable first step in breaking away from machine language programming.....**$265.00**

TANTALUMS PICKED TO CLICK

Tantalum capacitors, long a favorite of industrial contractors where price is no object, are famous for their low series resistance. Now, Godbout's is making them available to the electronics hobbyist at popular prices. The list below shows all tantalum capacitors known to be in existence at the Godbout warehouse.

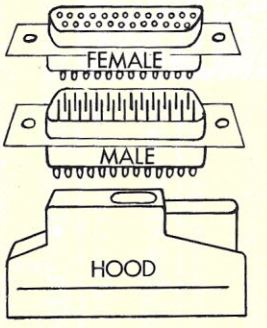
#CT0.47U	.47 uF 35V	4/$1.00
#CT2.2U	2.2 uF 20V	4/$1.00
#CT2.7U	2.7 uF 20V	4/$1.00
#CT3.3U	3.3 uf 15V	4/$1.00
#CT4.7U	4.7 uF 10V	4/$1.00
#CT22U	22 uF 10V	3/$1.00
#CT33U	33 uF 10V	3/$1.00
#CT39U	39 uF 10V	3/$1.00
#CT47U	47 uF 6V	3/$1.00

(advertisement)



T-SHIRT!
$5.00

Scientists discover missing link



Scientists have long puzzled over the "missing link" between computers and the outside world. Many have searched for this missing link, known in scientific circles as the DB-25 connector.

Extensive diggings at a certain manufacturer have resulted in the finding of this missing link by Godbout's trained researchers. They have isolated this missing link into three actual links, each of which performs a needed function in the crucial computer/outside world interface.

#CK-1004 - DB25P 25 pin RS-232 connector, sub mini D type, male plug with plastic hood. **$3.95**

#CK-1005 - DB25S 25 pin RS-232 connector, sub mini D type, female jack. **$3.95**

#CK-1006 - DB25H plastic hood, which slips over the male plug to keep dust and glop from gumming up your connector. **$0.90**

PARTS FORECAST

A cooling trend is forecast, with the warm TTL front being weakened by cooler, lower power ICs such as CMOS and low power Schottky. As this colder front moves in, we can expect lower prices and decreased emphasis on husky power supplies.

CMOS

4000	$0.25	4037	0.50
4001	0.29	4040	1.50
4002	0.34	4041	0.85
4007	0.29	4042	0.85
4008	1.28	4043	0.60
4009	0.53	4044	0.60
4010	0.53	4047	1.63
4011	0.29	4049	0.50
4012	0.29	4050	0.50
4013	0.50	4051	1.03
4014	1.23	4052	1.03
4015	0.90	4053	1.03
4016	0.45	4060	1.48
4017	1.23	4066	0.58
4019	0.55	4069B/	
4020	1.50	74C04	0.33
4021	1.23	4070	0.60
4022	1.20	4071	0.33
4023	0.29	4073	0.33
4024	1.03	4075	0.33
4025	0.29	4076B/	
4027	0.75	74C173	1.63
4028	1.00	4081	0.33
4029	1.73	4116	0.50
4030	0.53	14511	2.00
4033	1.50		

Low Power SCHOTTKY

74LS00	$0.30	74LS151	0.95
74LS01	0.30	74LS155	1.38
74LS02	0.30	74LS157	0.95
74LS04	0.33	74LS160	1.40
74LS08	0.36	74LS161	1.40
74LS10	0.30	74LS162	1.40
74LS11	0.36	74LS163	1.40
74LS12	0.33	74LS168	1.87
74LS14	1.38	74LS169	1.87
74LS15	0.30	74LS173	1.65
74LS20	0.30	74LS174	1.25
74LS21	0.33	74LS175	1.15
74LS22	0.33	74LS195	1.30
74LS26	0.43	74LS240	1.88
74LS27	0.36	74LS257	1.25
74LS30	0.30	74LS258	1.25
74LS32	0.38	74LS266	0.53
74LS37	0.45	74LS283	1.20
74LS38	0.45	74LS365/	
74LS42	0.98	80LS95	0.75
74LS47	1.00	74LS366/	
74LS48	0.98	80LS96	0.75
74LS74	0.50	74LS367/	
74LS75	0.68	80LS97	0.75
74LS76	0.50	74LS368/	
74LS86	0.50	80LS98	0.75
74LS109	0.50	74LS386	0.55
74LS125	0.63	81LS95	1.13
74LS126	0.63	81LS96	1.13
74LS132	1.25	81LS97	1.13
74LS138	1.10	81LS98	1.13
74LS139	1.15		

California Industrial

Post Office Box 3097 K • Torrance, California 90503



CALCULATOR WRIST WATCH

Designed for the on the go executive, that individual who has to make those on the spot decisions.

Handsome gold tone stainless steel watch features space age micro-circuitry. The MOS inte grated circuit contains the equivalent of more than 10,000 transistors.

This LED wrist watch displays date, time, elapse seconds and also functions as an eight digit calculator with memory. Information stored in memory can be recalled at any later date, even weeks or months. Use this memory feature to store phone numbers, parking stall location or flight departure time.

Manufactured by one of California's leading aerospace contractors. Because of the discount price we have agreed not to publish the manufacturer's name.

Includes batteries, jewelry case and 18-month factory warranty.

$149.50

ELECTRONIC ENTERTAINMENT CENTER

Tennis·Handball Hockey·Smash



Action-packed color entertainment for the whole family. Adjustable skill level controls allow players of all ages to compete in tennis, hockey and handball. This four game entertainment center turns your television into a video playground.

On screen scoring, live action sound and true component color makes this video center an excellent buy at only $24.88. Complete with antenna box and AC adapter.

Color $24.88

TELETYPE® MODEL 43



New from Teletype, the Model 43 is capable of printing 132 ASCII characters per line. Send and receive data at 10 or 30 words per second. Keyboard generates all 128 ASCII code combinations. RS-232 interface, same as the popular Model 33. Data sheet sent upon request. Manufacturer suggested price $1377.00, telephone for discount and availability.

We also have for sale a limited quantity of used Model 35's. Priced at only $449.50

TELETYPE

HEXADECIMAL KEYBOARD

$29.95

Maxi-Switch hexadecimal keyboards are designed for microcomputer systems that require 4-bit output in standard hex code.

Each assembly consists of 16 hermetically sealed reed switches and TTL "one shot" debounce circuitry.

Reliable low friction acetal resin plungers are credited for the smooth operation and long life of this premium keyboard.

Requires single + 5 volt supply.



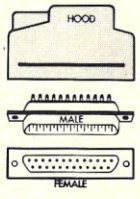
DIGITAL ALARM CLOCK

Completely Assembled $19.95



Walnut-grained decorator clock features large .7" LED display which is driven by the new National MM5385 alarm clock chip. Preset 24-hour alarm function allows you to awaken at the same time each morning without resetting. Upon reaching the wake-up time, the clock's loudspeaker emits a gentle tone. Touch the snooze button and doze off for an additional 9 minutes of sleep. Clock also functions as a ten-minute elapse timer. "Alarm Set" indicator, AM-PM display.

CONNECTORS

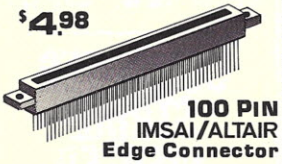


RS-232

DB25P male plug & hood **$3.95**

DB25S female **$3.95**

$4.98



100 PIN IMSAI/ALTAIR Edge Connector

Altair, Imsai compatible gold plated, dual 50 (.125 centers) three tier wire wrap edge connector. 3 for $13.50



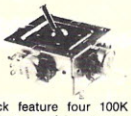
$24.88

SPERRY UNIVAC

KEYBOARD

The famous Sperry Univac 1710 Hollerith keyboard assembly is now available from California Industrial for only $24.88. The ideal computer input device for accountants and mathematicians. The numeric keys are placed on the lower three rows to resemble a ten key adding machine. This format allows one handed numeric data entry. Original cost was $385. Used but guaranteed in excellent condition. Complete with documentation.

JOYSTICK $5.50



This joystick feature four 100K potentiometers, that vary resistance proportional to the angle of the stick. Perfect for television games, quad stereo and radio controlled aircraft.

FREE

MANUAL GRAPHITE DISPLAY GENERATOR

Modern technology has pioneered the development of this unique character printer. Our Manual Graphite Display Generator has the capability of producing the full upper and lower case ASCII set. Self-contained cursor assembly allows the operator to eliminate erroneously entered information.

Each unit is manufactured to strict tolerances as prescribed by standards set forth by California Industrial. One free with every order.

$4.98 Scotch® BRAND

10 for $45. 3M COMPANY

DISKETTES

IBM 3740 series and compatible drives



CALCULATOR KEYBOARD



$2.98

Ideal for keyless entry systems, burglar alarms, Touch Tone or hexadecimal computer input code.

$3.98 Digital Clock



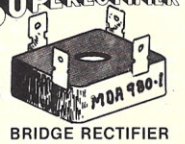
Manufactured for the Panasonic clock radio. The clock mechanism trips a microswitch upon reaching your preset wake-up time.

2708

$24.95

8K UV Erasable MEMORY

SUPERECTIFIER

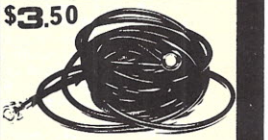


$1.95

BRIDGE RECTIFIER

MOTOROLA 12 Amp. 50 v.

$3.50



BNC CABLE

15 feet of RG-58U connector at ends

intel 2102AL

1k RAM 450ns

$1.19 Lowest Price Anywhere

7400	.13	7476	.39
7401	.19	7479	3.99
7402	.19	7480	.79
7403	.19	7482	.99
7403	.19	7483	.99
7404	.19	7485	.99
7405	.19	7486	.49
7406	.19	7488	3.40
7407	.25	7489	2.79
7408	.25	7490	.49
7409	.25	7491	.99
7410	.19	7492	.49
7411	.25	7493	.49
7412	.35	7494	.79
7413	.49	7495	.79
7414	.79	7496	.79
7416	.39	7497	3.99
7417	.39	74100	1.19
7420	.19	74107	.39
7422	.49	74109	.49
7423	.39	74110	1.79
7425	.39	74116	1.99
7426	.39	74120	1.79
7427	.39	74121	.39
7428	.49	74122	.39
7429	.39	74123	.69
7430	.25	74125	.59
7433	.39	74126	.59
7437	.39	74128	.49
7438	.39	74132	.99
7439	.39	74136	.89
7440	.39	74141	.99
7441	.89	74145	.99
7442	.59	74147	2.49
7443	.79	74148	1.99
7445	.89	74150	1.19
7446	.99	74151	.99
7447	.99	74153	.89
7448	.99	74154	.99
7450	.25	74155	.99
7451	.25	74156	1.29
7453	.25	74157	.99
7454	.25	74159	2.99
7460	.25	74160	1.19
7470	.25	74161	.99
7472	.39	74162	1.49
7473	.39	74163	.99
7474	.35		
7475	.49		

74164	1.19	4049	.79	**MEMORY**	
74165	1.19	4050	.79		
74166	1.19	4051	1.99	1702	5.95
74167	4.99	4052	1.49	82s23	2.95
74170	2.49	4053	2.19	82s123	2.95
74173	1.49	4060	3.19	2102	1.79
74174	1.19	4066	1.19	2102-1	1.89
74175	.99	4069	.49	21L02	1.19
74176	.99	4071	.49		
74177	.99	4077	.79		
74180	.99	4081	.49		
74181	2.49				
74282	.99	**CPU's**		**CLOCK's**	
74184	1.99				
74185	1.99	8080A	24.95	5314	3.95
74186	4.99	6800	24.95	5316	4.95
74190	1.19	280	69.95	5375	3.95
74191	1.19				
74192	.99				
74193	.99				
74194	1.19				
74195	.99				
74196	1.19				
74197	.99				
74198	1.49				
74199	1.99				
74273	1.99				
74290	.99				
74366	.99				
74390	1.79				
74939	1.79				
74490	1.99				

LM741 $.09*

CMOS

4000	.25	300H	.79	340T-24	1.79
4001	.25	301H	.39	350N	.99
4002	.25	301CN	.39	351CN	.65
4006	1.99	302H	1.29	370H	1.29
4007	.25	304H	1.29	370N	1.29
4008	1.49	305H	.99	373N	3.19
4009	.69	307H	.49	377N	3.99
4010	.69	307CN	.39	380N	1.39
4011	.25	308H	.99	381N	1.79
4012	.25	308CN	.99	382N	1.79
4013	.49	309H	1.09	NE555v	.49
4014	1.49	309K	.99	NE556	1.29
4015	1.39	310H	1.19	NE565H	1.49
4016	.69	310CN	1.19	NE565N	1.79
4017	1.29	311H	.99	NE566N	1.25
4018	1.69	311N	.99	703CN	.45
4019	1.79	312H	1.99	709H	.39
4020	1.39	318H	1.79	709N	.39
4021	1.49	318CN	1.49	710N	.79
4022	1.25	319CN	1.29	711H	.39
4023	.25	320K-5	1.39	711N	.39
4024	1.19	320K-12	1.39	723H	.55
4025	.25	320K-15	1.39	723N	.55
4027	.69	320T-5	1.75	725H	3.49
4028	1.25	320T-8	1.75	733H	1.49
4029	1.99	320T-12	1.75	733N	.99
4030	.69	320T-15	1.75	739N	1.19
4032	.49	320T-24	1.75	741N	.09
4033	1.99	324N	1.79	747N	.79
4035	1.69	339N	1.69	748H	.39
4040	1.99	340K-5	1.95	748N	.39
4041	1.49	340K-8	1.95	1414N	1.75
4042	1.49	340K-12	1.95	1458	.69
4043	1.49	340K-15	1.95	1496N	.95
4044	1.49	340K-18	1.95	2111N	1.95
4046	2.49	340K-24	1.95	2901N	2.95
4047	2.49	340T-5	1.79	3065N	.69
		340T-12	1.79	3900N	.49
		340T-15	1.79	3909N	1.19

*We want to give them away — but our accountants won't let us. So instead we are selling them at cost. And therefore must limit the purchase of the SN7400 and the LM741 to 50 per customer.

commodore

Personal Electronic Transactor



Finally a complete small system computer that anyone can afford. New from Commodore International, the Personal Electronic Transactor. The system includes input keyboard, tape cassette transport, MOS6502 CPU and 4K of user memory in addition to the 14K of operating resident software. Also included is a "ten-key" numeric entry pad and a 9" video display screen. Manufacturer suggested price is $595.00. Telephone for discount and availability.

$595.00

SOLID-STATE

$.98



1.5 TO 3 VDC

MICRO BUZZER

Thumbwheel switch



Ten position **BCD**

$1.39 ea.

10	50
$1.19	.89

SPDT MINIATURE TOGGLE SWITCH

$.98 ea.

10	50	100	1k
$.88	.81	.73	.66

TRIMMER POTENTIOMETERS

2K 10K 50K

5 for $.98



20	50	100
16¢	14¢	12¢

CAPACITORS

ELECTROLYTICS

	ea.	10	50
4500/50v.	$1.49	135	119
1000/15v. axial	$.55	.49	.45

.1 disc	$.12	10	08
.01 disc	.06	.05	.04



$.98 ea.



DPDT ROCKER SWITCH

DIP Switch

$1.95 ea.

10	100	1k
$1.74	1.52	1.29



8x SPST

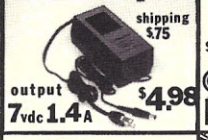


32 Conductor Ft. $.59

RIBBON WIRE

SPECTRA-STRIP

COMPUCORP Power Adapter



shipping $.75

output 7vdc 1.4A

$4.98

COMBINATION LENS MOUNTING DEVICE

5 for $.98 Red Amber Green

20	50	100	1k
17¢	15¢	13¢	11¢

CLIP LITE

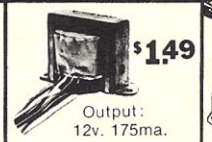
Transistors

	ea.	10	50	100
2N2222A	.20	.18	.16	.15
2N3055	.89	.84	.77	.65
MJ3055	.99	.94	.87	.75
2N3772	2.19	1.95	1.75	1.59
2N3904	.15	.11	.09	.07
2N3906	.15	.11	.09	.07

Diodes

	10	25	100
1N4002 100v.	.08	06	.05
1N4005 600v.	.10	.08	.07
1N4148 signal	.07	.05	.04

jumbo red **LED's** ea. 10 25 100 $1 5.13.11.09



$1.49

Output: 12v. 175ma.

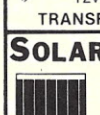
TRANSFORMER

9 foot $1.49



Heavy duty grounded power cord and mating chassis connectors.

SOLAR CELLS



$1.19

10	100
$.98	$.85

125mA. at .43V. Ideal for powering radio receivers or charging batteries.

$1.19



"AA" FAST CHARGE

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pin	wire wrap ea.	25	50	solder ea.	25	50
8				17¢	16	15
14	37¢	36	35	20	19	18
16	38	37	36	21	20	19
24	99	93	85	36	35	34
40	169	155	139	63	60	58

50ft. $.98 KYNAR WIRE WRAP

500	1,000	11,000
$9.	$15.	$105.



Battery wire wrapping tool **$24.95**

$29.95

OK HOBBY WRAP-30 wire wrap & strip tool

$5.45

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Reader inquiry card number C-50

SYSTEM SPECIALS

ADDITIONS TO OUR GIANT SYSTEMS BUILDERS' CATALOG

★CWS4 Hardcopy Terminal, Papertape I/O, SWTPC 6800 KIT



Here's one of our favorite combinations of microcomputer kits and our own low cost Olivetti (90-day used gear warranteed) teletypewriters. The Olivetti 318 has all the features of a standard Teletype ASR 33, but we find it a lot easier to use than a teletype. In addition it has a 10-key numeric pad for fast input of numerics. Operating in low light levels is o.k. because the Olivetti has a small fluorescent light in the platen area. The machine is much quieter. Tape reader/punch operates at 10 char/sec, RS232, includes manual, parts available from Olivetti. In this package we are also including a Potter line filter for the SWTPC 6800 to insure years of trouble-free operation.

$1216 complete, Olivetti alone $875, Potter line Filter $25, Shipping additional

★CWS5 CRT, Digital Tape Drive I/O, 16K IMSAI KIT

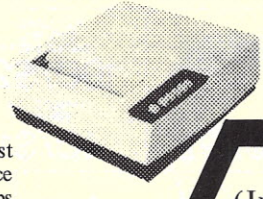


This is a top notch system and the Techtran Digital Cassette tape drive (90-day used gear warranteed) really establishes the system for solid heavy use. The drive features ASCII RS232 interface, off-line on-line operation, 110 to 300 baud, automatic BOT/EOT operation, 70,000 character capacity, runs directly from terminal. Combined with the 16K Imsai is our popular Hazeltine 1000, 12 x 80 CRT display (90-day used gear warranteed), 64 character ASCII, 32 ASCII control codes: 110, 300 baud. With the Imsai are 20 Viking sockets for the motherboard, serial I/O, 16K RAM and cable A.

$2493 complete, Hazeltine 1000 alone $695, Techtran Digital Tape alone $595 & shipping

THERMAL PRINTER

Compact table top unit ideal match in size to our Monitor



This NCR Thermal Printer is parallel but most models also have a Datapoint serial interface board too. 80 col, 96 char. Up to 30 cps

$375 & shipping.

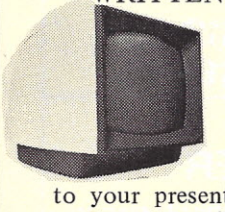
Terminal Prices Cut
Hazeltine 1000 now $695
Built ADM-3 New now $895

KITS AND UNITS
(Just a sample from our line)

UP to 20% OFF see our catalog

● SCAMP KIT COMPUTER KIT	$99	● IMSAI 8080A KIT 22 SLOT ..	$751
KEYBOARD KIT	95	4K MEMORY KIT	139
● SWTPC 6800	395	SERIAL I/O KIT	125
CT 64 TERMINAL KIT	325	65K RAM CARD	3899
AC30 AUDIO INTERFCE	79.50	32K RAM BOARD ..... KIT	749
GT61	99	ASSEMBLED	1099
PP40 PRINTER	250	16K RAM BOARD ..... KIT	499
SMOKE SIGNAL BROADCASTING 16K	595	ASSEMBLED	679
● INTERCEPT JR. 12K RAM	145	PROM 4-512 KIT	165
● KIM-1 6502	245	VIKING 100 PIN CONNECTORS, HEAVY DUTY	3.00

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*Ideal for SWTPC 64 or 1024 CRT terminal kit

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★ Imsai - Altair "A" Compatible Kits ★

Z-80 CPU KIT COMPLETE - $149. kit

Z-80 Chip & Manual $49.95 Z-80 Manual - $7.50 Separately

From the same people who brought you the $89.95 4K RAM KIT. We were not the first to introduce an Imsai/Altair compatible Z-80 Card, but we do feel that ours has the best design and quality for the lowest price!
The advance features of the Z-80 such as an expanded set of 158 instructions, 8080A software compatibility, and operation from a single 5VDC supply, are all well known. What makes our card different is the extra care we took in the hardware design. The CPU card will always stop on an M1 state. We also generate TRUE SYNC on card, to insure that the rest of your system functions properly. Dynamic memory refresh and NMI are brought out for your use. Believe it or not, not all of our competitors have gone to the extra trouble of doing this.
As always this kit includes all parts, all sockets, and complete instructions for ease of assembly. Because of our past experience with our 4K kit we suggest that you order early. All orders will be shipped on a strict first come first served basis. Dealers inquiries welcome on this item. Kit includes Zilog Manual and all parts. Kit shipped with 2 MHZ crystals.

THE WHOLE WORKS **$89.95**

4K LOW POWER RAM BOARD KIT

Imsai and Altair 8080 plug in compatible. Uses low power static 21L02–1 500 ns. RAM'S. Fully buffered, drastically reduced power consumption, on board regulated, all sockets and parts included. Premium quality plated through PC Board. *For 250 ns RAM's add $10.00*

NEW! DESIGN CONSOLETTE KIT - $89.95

S.D. Sales announces the inexpensive way to beat the wire wrap jungle. Our latest kit gives you 124 solderless quick connect terminals, enough for eight 16 pin IC's and provides 50 x 8 common buss matrix. Has regulated +5VDC and +/– 15VDC, all at 1 AMP. Voltage regulation at 100%. Also includes a pulse generator variable from 10hz to 50mhz and .01 sec. to 100 nano seconds. Generator output is +5V. In kit form only and includes all parts, sockets; front panel measures 7¼"x8¼", and hardware. case not available.

CAR/BOAT KIT *New Item!*
$34.95
Music to your Ears!

MUSICAL HORN

Musical Horn Kit for car, boat, or home. Plays any tune from Mozart to Led Zeppelin. Change tunes in seconds; complete solid state electronics. Standard or custom tunes available at $6.95 each (you supply us with the sheet music – we supply electronics for your favorite tune.) One song supplied with original order. Standard tunes available: DIXIE – EYES OF TEXAS – ON WISCONSIN – YANKEE DOODLE DANDY – NOTRE DAME FIGHT SONG – PINK PANTHER – AGGIE WAR SONG – ANCHORS AWAY – NEVER ON SUNDAY – BRIDGE OVER RIVER QUI – CANDY MAN.

HOME KIT
$26.90
Home kit includes speaker which operates from your door bell. When door bell is pushed your favorite tune is played. Car/boat kit DOES NOT include speaker. Uses standard 8ohm PM speaker. Allow 4 weeks delivery on both kits.

Limited Quantity!
$9.95 kit

6 DIGIT ALARM CLOCK KIT

We made a fantastic kit even better. Redesigned to take advantage of the latest advances in IC technology. Features: Litronix Dual ½" displays, Mostek 50250 super clock chip, single I.C. segment driver, SCR digit drivers. Greatly simplified construction. More reliable and easier to build. Kit includes all necessary parts (except case). For P.C. board add $3.00; AC XFMR add $1.50. Do not confuse with Non-Alarm kits sold by our competition! Eliminate the hassle – avoid the 5314!
NEW! WITH JUMBO LED READOUTS!

1000 MFD Filter Caps	SLIDE SWITCH Assortment	POWER RESISTOR 15 OHM 25W BY CLAROSTAT	RESISTOR ASSORTMENT	P.C. LEAD DIODES 1N4148/1N914		DISC CAP ASSORTMENT
Rated 35 WVDC Upright style with PC leads. Most popular value for hobbyists.	Our best seller. Includes miniature and standard sizes, single and multi-position units. All new.		¼W 5% & 10% PC leads. A good mix of values! Special!	100/$2. 1N4002 - 1A 100 PIV	Just received a good mixed lot of National TO-92 plastic transistors. PNP & NPN, even a few FET's. 40-50% yield. Untested Asst.	P.C. Leads. At least 10 different values. Includes .001, .01, .05 plus other standard values.
4/$1.00	12/$1.00	75¢ ea.	200/$2.	40/$1.	500/$3.	60/$1.00

AMD-1702A

Huge Factory Purchase

FACTORY PRIME UNITS! BRAND NEW!
1.5 Micro-Seconds Access Time.
10/$40. $4.95 ea.

★ *Special!* ★

3.579545 MHZ Time Base Crystal $1.25	11,000 MFD 50WVDC Computer Grade Cap $3.00 each
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FACTORY PRIME! 21L02-1

Not only are our RAM'S faster than a speeding bullet but they are now very low power. We are pleased to offer prime new 21L02-1 Low Power and Super Fast RAM's. Allows you to STRETCH your power supply farther and at the same time keep the wait light off!

500ns 8/$12.95
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IC's REMOVED FROM PC BOARDS ALL TESTED; FULL SPEC.

IC's from XEROX

1402 A Shift Regulator – 50c
MH0025CN – 55c

Great Buy!

7400 – 9c	7430 – 9c	7493 –26c
7402 – 9c	7440 – 9c	74121 –22c
7404 – 9c	7437 –10c	74123 –32c
7406 –11c	7438 –10c	74151 – 9c
7407 –11c	7451 – 9c	74155 –22c
7410 – 9c	7474 –16c	74193 –35c
7416 –13c	7475 –24c	8233 – 35c
7420 – 9c	7486 –16c	Intel – 1302 – 45c

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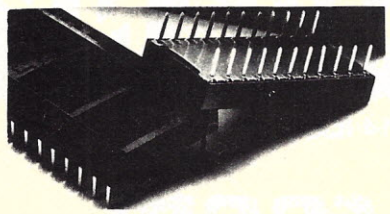
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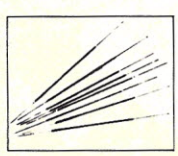
Low Profile DIP Solder Tail (Tin)

	1-9	10-24	25-100
SKT-0802 8 pin	.15	.15	.14
1402 14pin	.18	.17	.16
1602 16pin	.20	.19	.18
1802 18pin	.27	.26	.25
2002 20pin	.29	.28	.27
2202 22pin	.35	.34	.33
2402 24pin	.36	.35	.34
2802 28pin	.42	.41	.40
4002 40pin	.60	.57	.53



3 Level Wire Wrap Gold

	1-9	10-24	25-100
SKT-1400	.38	.37	.36
1600	.42	.41	.40
1800	.73	.65	.59
2400	1.00	.91	.83
4000	1.69	1.51	1.37



PRESTRIPPED WIRE WRAP WIRE

Highest quality 30 ga. Kynar insulated silver plated wire for wrapping. Stripped 1" on both ends. Indicated lengths are lengths of insulated portion. Packed 100 per sturdy plastic vial or 1000 per poly bag. Compare our prices!!!. Available in Black, Red, Yellow and Green. State color desired.

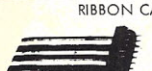
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RIBBON CABLE IC INTERCONNECTS





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No Of Pins	Length 6"	12"	18"	24"	36"	48"
14P	1.51	1.62	1.72	1.83	2.05	2.26
16P	1.64	1.76	1.87	1.99	2.21	2.44
24P	2.49	2.69	2.88	3.08	3.48	3.87
DOUBLE END						
14P	2.76	2.87	2.97	3.08	3.30	3.51
16P	3.01	3.13	3.24	3.36	3.58	3.81
24P	4.55	4.75	4.94	5.14	5.54	5.93



OK WIRE WRAP TOOLS
BW-630 GUN.....$34.95
HW-30 Tool.....$5.95
HW-30M Tool.....$6.95
FREE, 50 roll of wire wrap wire with purchase of tool!

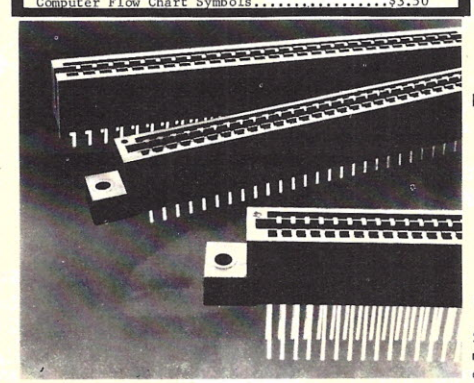
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3/4 Size.....$3.50
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100 PIN MINICOMPUTER PC CONNECTORS
2 x 50 with .125" spacing. Solder tail or wrap terminals. PCC-100STN (solder) . . . $3.75 PCC-100WWN . . . $3.75 4/$14.00

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1N967B.. 18V, 5%, ½W Zener..... 5/$1
42501-1 Quad Hi speed NPN transistor in 14 pin DIP package. Similar to Motorola MPQ3303..... 5/$1

MCM6571A is an 8192-Bit Horizontal-Scan (Row select) character generator with shifted characters. It contains 128 characters in a 7X9 matrix, and has the capability of shifting certain characters that normally extend below the baseline, such as j,y,g,p and q. A 7-bit address code is used to select one of the characters.

Features:
.Static operation
.TTL compatability
.CMOS compatability (5V)
.Shifted character compatability
.Includes Greek alphabet
.Maximum access time =500nS

(See article in March '77 issue of 73 Magazine for applications including TV-Computer interface)
MCM6571A..... $9.95
Specs..... $1.00

MM5320 TV SYNC GENERATOR I.C.

Generate all the sync pulses necessary for camera or video terminals. Use with MCM6571A in the TV-Computer interface. MM5320N.....$18.80
Specs..... 60¢

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Think about it-- how many times have you seen an application for device with 7 segment readout if only you had the output in BCD? Calculators, clocks, timers and the like can now be read into your mini'puter with minimum conversion hassel. CMOS for low power drain. Latched.
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Spec..... .30

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½" hexagonal metal jacket stud mount with 2" stab-on wire terminals. #KBS06..(Mfd. by G.I.).....89¢

MC14412VP Universal Modem Chip..... $16.95

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Single chip for generating selectable frequencies for equipment in data communications such as TTY, printers, CRT s or microprocessors. Generates 14 different standard bit rates which are multiplied under external control to 1X, 8X, 16X or 64X initial value. Operates from single +5 volt supply. MC14411..... $11.98
4 pages of data..... .40
Crystal for the above..... $4.95

- Accuracy: ±0.05% of Reading ±1 Count
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- Up to 25 Conversions/s
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- Auto-Polarity and Auto-Zero
- Single Positive Voltage Reference
- Standard B-Series CMOS Outputs—Drives One Low Power Schottky Load
- Uses On-Chip System Clock, or External Clock
- Low Power Consumption: 8.0 mW typical @ ±5.0 V
- Wide Supply Range: e.g., ±4.5 V to ±8.0 V

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Single chip combines linear and CMOS digital to bring you the simplest yet DVM approach. Requiring only 4 external passive parts, this subsystem gives you: Auto polarity, auto zero, single voltage reference, 8 mW operation, overrange, underrange signals, 25 conversions per second and .05% ± 1 count accuracy! 100 uV resolution. 24 Pin DIP.
MC14433P.....with specs.....$19.55

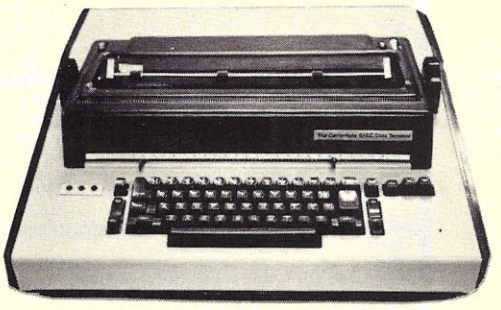
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the computer room

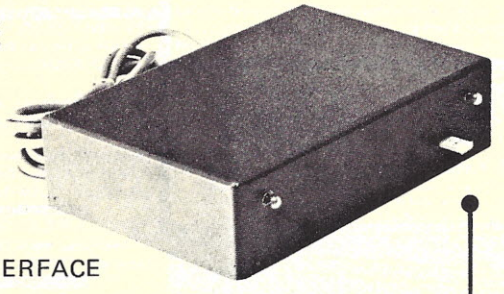


Specifications
- Size: 21" wide x 21" deep x 8" high
- Power Input 115 Volt 60 Hz
- Interface: RS232
- Weight: 54 lbs. (Shipping Weight 65 lbs.)
- 15" Carriage
- Input/Output rates to 15 characters per second
- EBCD Code
- Half Duplex
- 132 Print Positions, 10 Pitch
- Can be used off-line

Used
Working
(Non Refurbed) $695.
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(Refurbed) $895.
Software to connect ASCII Output of 8080 Class Processor to Selectric: Code $25
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SELECTRIC TERMINAL (IBM Selectric Mechanism, Heavy Duty, Datel Electronics)

CARTERFONE MODEL 318 ASYNCH MODEM



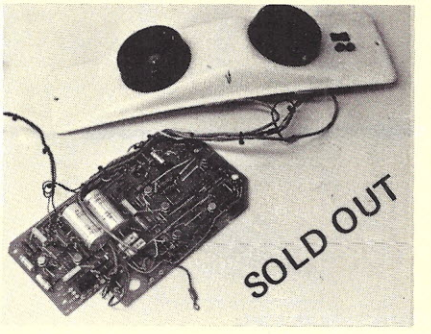
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- TTY OR RS-232B INTERFACE
- ORIGINATE ONLY
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USED – UNTESTED . . $25.00
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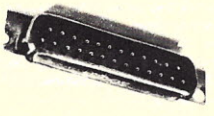


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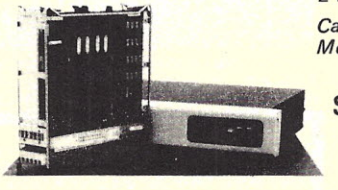
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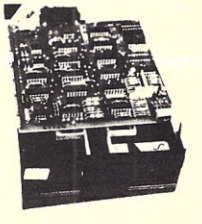


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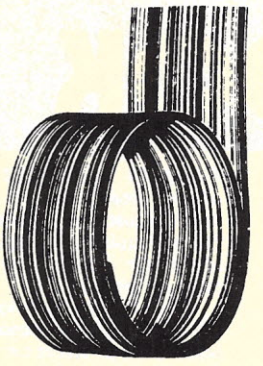
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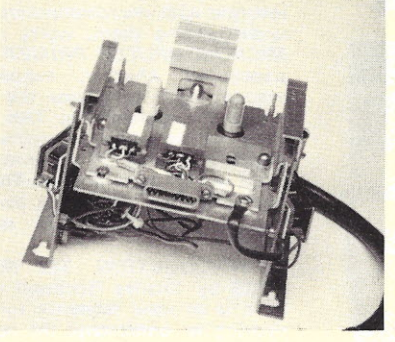
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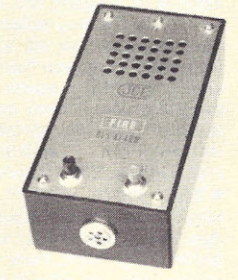
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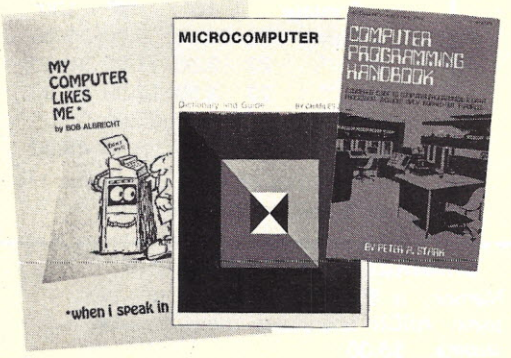
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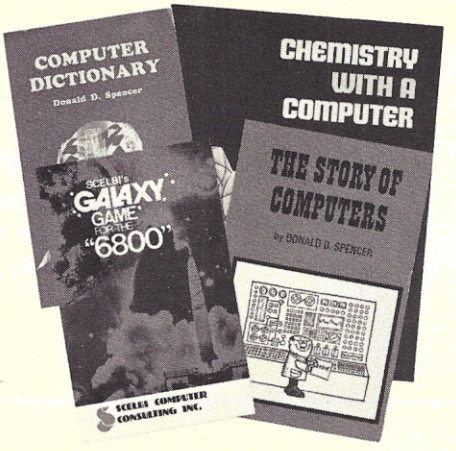
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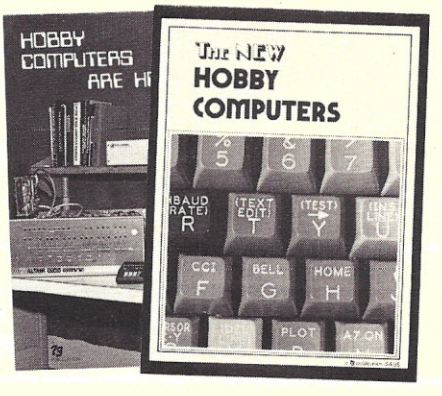
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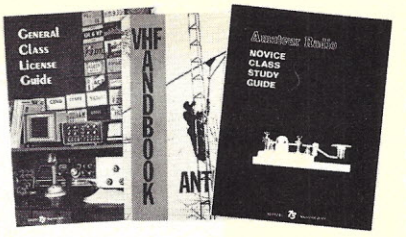
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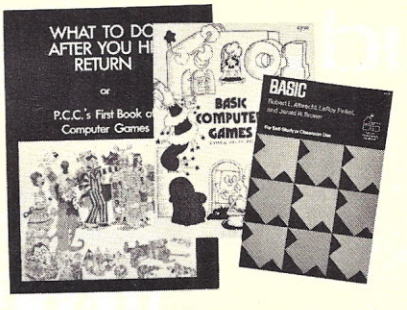
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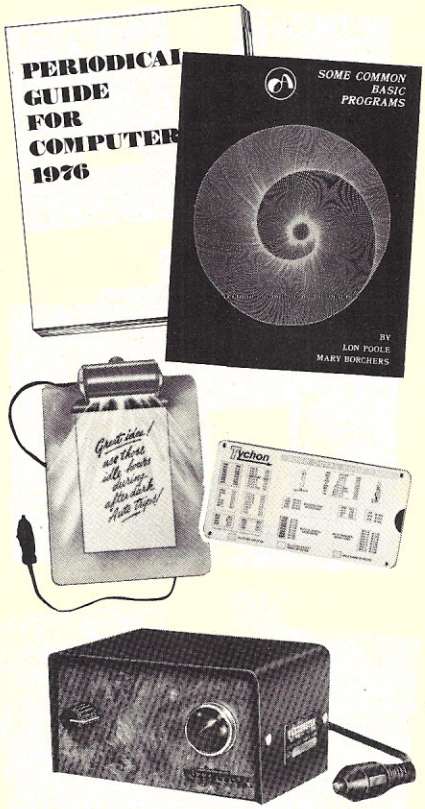
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During the last year or so there have been over 300 pages of computer articles and nearly as many which are of interest to the average computerists.

In recent issues there have been articles on computerized satellite tracking (with software), RTTY using a uP, using old (inexpensive) Teletypes, building a Polymorphic video board, making instant PC boards using the new color-key technique, the TTL one-shot, what computers can and can't do, a hamshack file handler (software), the bit explosion — 8-12-16?, backward branch the easy way with the 6800, the hexadecimal . . . etc.

Any one of these articles could easily be worth the cost of a full year of *73*. One good program could save you days of work. One good interface project could make an enormous difference. In general, *73* tries to present not too complicated construction projects . . . things you can make in a day or two.

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GLOSSARY

Tim Barry

FLOAT: An input which is not being loaded or driven is said to be floating. Floating inputs pins are susceptible to noise, and they should always be pulled up or down to a known state. For example, unused TTL inputs will float at a logic high level. However, good design practice dictates that all unused TTL inputs be pulled up to Vcc through a pull-up resistor. Floating CMOS and low power Schottky inputs can be pulled up with or without resistors, but it is still important to force them into a known state.

FORMATTING: The general act of ordering information for input to or output from the computer or a peripheral. In particular, it is often used in the preparation of output that is to be used by the human operator. When you set up the output of your BASIC program to print a nice, easy-to-read table you are formatting the output.

Formatting is also used to refer to the preparation of magnetic media to accept data. For example, before a floppy disk can be used it must first be formatted with track and sector information required by the disk controller. After it is formatted, the disk can then be used for normal I/O operations.

MASK: A bit pattern used in conjunction with logic operations to test or modify bits in a data word. Masking is often used to modify the format of data being transferred between the computer and a peripheral. Consider the following bit pattern corresponding to the ASCII character "A" with odd parity:

11000001

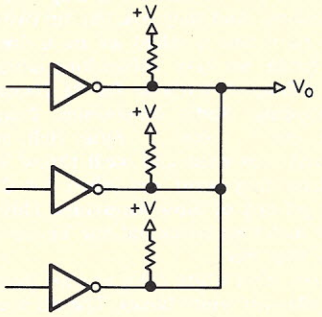
Suppose we need to send that character to a device which requires even parity. We must mask bit seven (the parity bit) to a zero. To do that we use the mask 01111111 and the logic AND (Λ) operation:

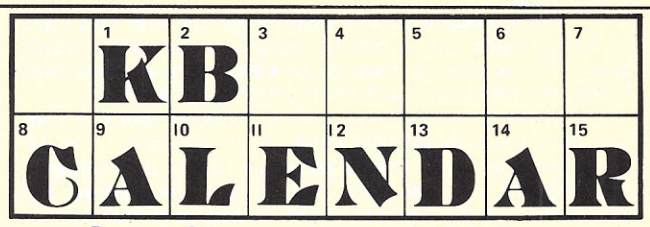
$$\begin{array}{r} 11000001 \\ \Lambda\,01111111 \\ \hline 01000001 \end{array}$$

The selected bit has been masked to a zero and the rest of the data is unmodified.

STEPPING PULSE: A control signal used to cause an incremental action by some device external to the computer. Most often, a stepping pulse is used to control the motion of an incremental (or stepping) motor. Each time a pulse is received, the motor shaft rotates a fixed amount. Most high-speed paper tape readers have a stepping motor attached to the tape feed sprocket wheel. Each pulse received then causes the sprocket to step the tape forward one character.

WIRED OR: This technique, also known as *Dot OR, Implied OR, Virtual OR, OR Tied, Phantom OR,* and *Etch OR,* refers to the connecting together of the active outputs of two or more logic circuits. The result is an implied logic function. The term is actually a misnomer since, as shown in the example below, the output of the circuit will be high only when the outputs of all the ORed devices are high. This makes it a logic AND function. The technique is commonly used, but it is really best avoided. It makes isolation of the bad part in the system very difficult, and can lead to really difficult debugging.





Pomona CA

The Pomona Valley Chapter of the SCCS held its first meeting May 19, and discussed ideas for future programs and club activities.

Meetings are held from 7 to 9 p.m. at the Pomona Public Library, 625 S. Garey Ave., Pomona CA.

For additional information contact: Al Sutton, 4155 Oak Hollow Rd., Claremont CA 91711, (714) 593-6635 evenings.

Birmingham AL

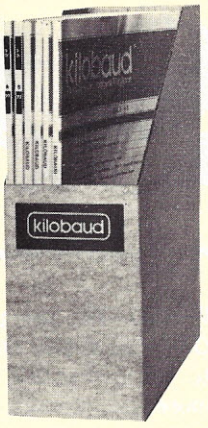
The Birmingham Microprocessor Group, a club devoted to the interests of the computer hobbyists in and around the Birmingham area.

The club now has approximately 35 members, and meets on the forth Sunday of each month at the Southcentral Bell Company headquarters building, at 2 p.m. Contact Jim Anderson, 2931 Balmoral Rd., Birmingham, AL 35223 (205) 879-9630.

Nebraska

Omaha and Bellevue, Nebraska each have a computer club. The Omaha Microprocessor Amateur Hobbyist Association (O.M.A.H.A.) meets twice a month at Northern Natural Gas Company. MACH, in Bellevue, meets on the second Thursday of the month in the commercial Federal Building in Bellevue. For more information, contact O.M.A.H.A., c/o Rita Bianchi, S & DP – 4th floor, Northern Natural Gas, 2222 Dodge, Omaha NE 68102, or MACH c/o Thomas Smith, 2708 Calhoun Street, Bellevue NE 68005.

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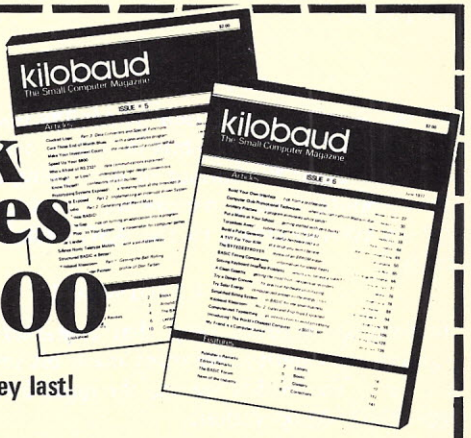
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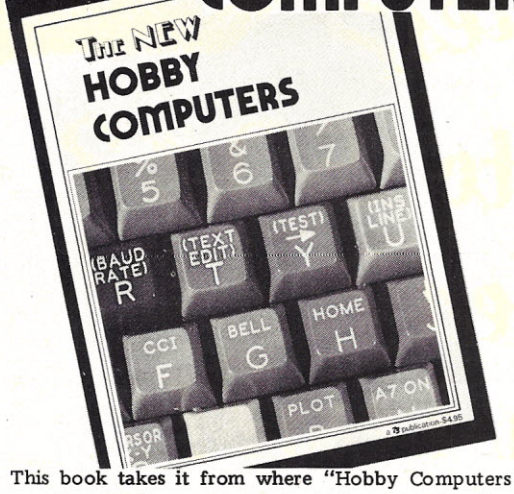
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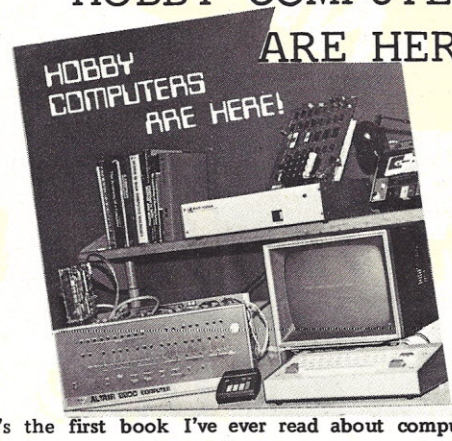
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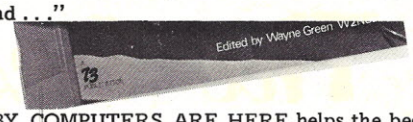


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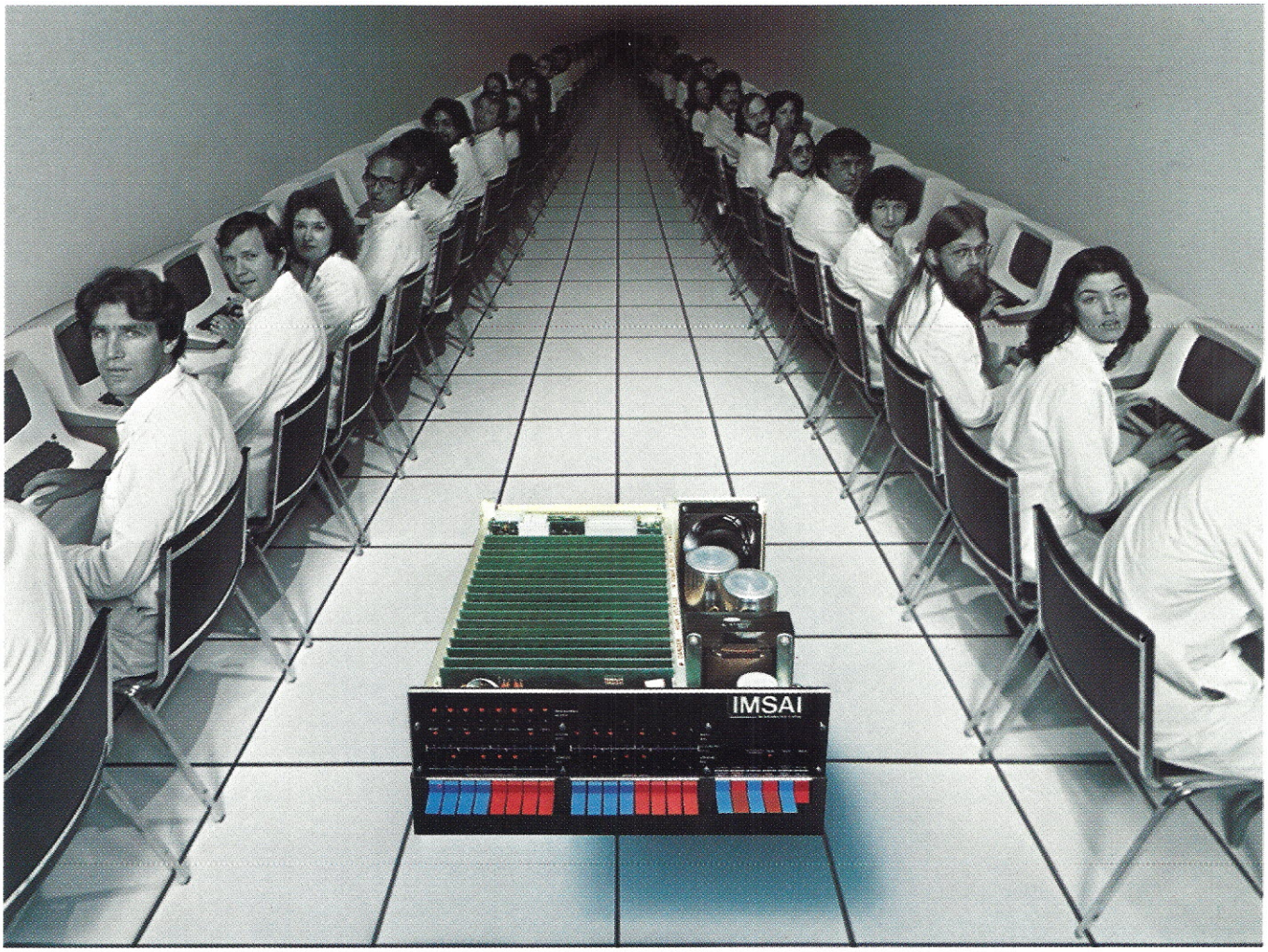
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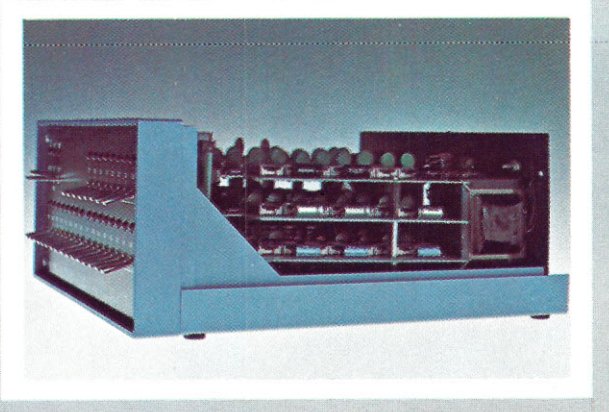
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